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WILLIAM HUGGINS, ESQ., F.R.S., President, in the Chair.

Frederick Newton, Esq., Hill Side Lawn, Hornsey Lane, was balloted for and duly elected a Fellow of the Society.

On a Peculiarity of Personal Equation.

By Capt. W. M. Campbell, R.E.

The following remarks on what is to me a novel feature of "Personal Equation" may prove of some interest.

Since the end of 1875 I have been employed, in association with Capt. Heaviside, R.E., on the determination of differential longitudes in India, by means of the Electric Telegraph.

In such operations, Personal Equation being a matter of first importance, we devoted nine nights, at intervals throughout the course of observations in 1875–6, to the determination of our relative equation.

The method followed was always that of "divided transits," in which one observer takes the first portion of a star's transit, and the second finishes the observation at the same telescope.

I should note that the transit instruments used are powerful telescopes, by Cooke & Sons, of about 5 ft. focal length, with 5-in. objectives.

The wires are 25 in number, in tallies of 5 each, the intervals being about $2\frac{1}{2}$ sec. between wires, and 5 sec. between tallies.

We always observed with an oblique eye-piece, so that the line of sight was at right angles to the axis of the telescope, and stars were observed with their actual motion.

A chronograph being used, it is easy for observers to change places in the middle of a transit, observing it over the first and last 10 wires respectively, supposing, at least, that no change is

required in the adjustment for focus of eye-piece. In taking a set of such transits (we generally took 20 on each night), the order of observation was alternated; thus the observer who took the last part of one transit observed the first portion of the next.

The value of our relative equation, adopted from all such observations, was $C-H = +0^{s}\cdot064 \pm 0^{s}\cdot0057$, Capt. Heaviside observing in advance of me.

When near the completion of the reduction of our observations of 1875–6 generally, we discovered that we had two distinct equations when observing imitation transits, according as the motion of the object was from right to left or left to right.

This led to a re-discussion of all the observations of "divided transits," arranged in two sets—viz. North Zenith Stars, or those moving from right to left, and South Zenith Stars, or those moving from left to right—with the following results:—

$$\text{By NZ Stars, } C-H = +0^{s}\cdot124 \pm 0^{s}\cdot0087$$

$$\text{„ SZ „ } C-H = +0^{s}\cdot040 \pm 0^{s}\cdot0034$$

The application of these equations, instead of the one first adopted, very much improved our general results.

On resuming observations this season—1876–7, we agreed to observe every close Zenith star on both sides, i.e. to observe it as a North Zenith star over the first 10 wires, and then, reversing the eye-piece, to take it as a South star over the last 10 wires, or *vice versâ*, stars being observed in each order nearly equally.

From 21 stars observed by me in this way during January, I find my equation to be

$$N-S = +0^{s}\cdot077 \pm 0^{s}\cdot0067$$

my observation of North stars, moving from right to left, being slower than that of South, or left to right moving, stars by $0^{s}\cdot077$. I have not yet heard the result of similar observations by Capt. Heaviside.

Bombay,
1877, *March* 19.

Observations of the Phenomena of Jupiter's Satellites at the Observatory, Adelaide, and Notes on the Physical Appearance of the Planet. By Charles Todd, Esq., C.M.G.

The Astronomer Royal has received from Charles Todd, Esq., of the Observatory, Adelaide, the following communication and observations of *Jupiter's* Satellites:—

"Enclosed I send you, for the Royal Astronomical Society, my first contribution of observations of *Jupiter's* Satellites, and a few rough sketches made at the Adelaide Observatory this year. I hope to do better at next opposition.

"In connection with these observations there are two or three things which may be worth mentioning, as I am not sure they have been so well seen before.

"On one or two occasions when a satellite has been on the point of occultation, it has appeared to be projected on the disk of the planet; or rather, as it appeared independently to my assistant (Mr. Ringwood) and myself, as if seen *through* the edge of the planet, as if the latter were surrounded by a transparent atmosphere laden with clouds. I noticed this on two occasions, viz. on August 21, at the disappearance of the 1st satellite, when the satellite was distinctly seen on or through the edge of the disk for about 2 minutes before disappearance—I say *through* the edge of the disk because the satellite was less bright than in a similar position at a transit—and again at the disappearance of the 2nd satellite on August 28. Mr. Ringwood also noticed it on August 12 and August 19, at occultation of 1st and 3rd satellites. In each instance the planet was splendidly defined—better than I ever remember to have seen it in England. It was not noticed at any reappearance which took place at the eastern or defective limb; the gibbosity of the planet was, however, quite sensible at reappearance, when the planet was near quadrature—*vide* Oc. R. of 3rd satellite on August 19, and of 2nd satellite on August 21, when the satellite at instant of emergence was sensibly separated from the illuminated edge of the planet.

"The shadow of the 3rd satellite, when in mid-transit along a high northern parallel on August 30, appeared to me to be visibly oval or flattened at its poles, the definition being all that could be desired. On several occasions at ingress of shadow I was surprised at the marvellous sharpness, the minutest indentation of the limb being at once detected.

"The phenomena on August 21 were singularly beautiful; the 2nd satellite, as it emerged from behind the planet, immediately passed into the shadow, subsequently reappearing within a few minutes of the reappearance of and close to the 1st satellite; the two forming a pretty coarse double star.

"The sketches, which were taken for the Jovian Committee of the Royal Astronomical Society, are perhaps not worth much, but they are fairly faithful. I was much impressed on some nights with the sudden and extensive changes in the cloud belts, as though some tremendous storm was in progress on the planet's surface, changing the form and dimensions of the cloud belts in an hour or two, or even less. I hope to do better next year, but trust that this humble contribution to Jovian Astronomy may not be without interest."

Observations of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8-in. Equatoreal (Cooke) at the Adelaide Observatory, South Australia.

	h	m	s	
Longitude	9	14	21·3	East.
	°	′	″	
Latitude	34	55	33·8	South.

1876.

Reference No.	Observer.	Day of Observation. 1876	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time. h m s	Corresponding Greenwich Mean Time. h m s	Greenwich Mean Time by *Nautical Almanac.* h m s	Apparent Error of *Nautical Almanac.* m s	Power.
1	T	June 13	I	Oc. D.	External contact	6 21 9·50	21 6 48·20			200
2	,,	,, ,,	,,	,,	Bisected	6 23 4·50	21 8 43·20	21 14		,,
3	,,	,, ,,	,,	,,	Internal contact	6 27 32·00	21 13 10·70			,,
4	T	,, 22	I	Ec. R.	First seen	5 37 39·35	20 23 18·05	20 23 30·4	+0 12·35	,,
5	T	,, 23	III	Ec. R.	First seen	6 24 43·80	21 10 22·50	21 14 5·9	+3 43·40	,,
6	T	,, 25	II	Ec. R.	First seen	12 54 45·80	3 40 24·50	3 43 11·2	+2 46·70	,,
7	T	,, 28	I	Tr. I.	External contact	7 9 22·10	21 55 0·80			,,
8	,,	,, ,,	,,	,,	Bisected	7 11 30·10	21 57 8·80	21 55		,,
9	,,	,, ,,	,,	,,	Internal contact	7 13 18·10	21 58 56·80			,,
10	T	,, ,,	I	Tr. E.	Internal contact	9 15 51·94	0 1 30·64			,,
11	,,	,, ,,	,,	,,	Bisected	9 18 26·94	0 4 5·64	0 8		,,
12	,,	,, ,,	,,	,,	External contact	9 20 20·43	0 5 59·13			,,
13	T	,, ,,	I	Sh. E.	Internal contact	10 10 33·36	0 56 12·06			,,
14	,,	,, ,,	,,	,,	Limb indented	10 12 24·86	0 58 3·56	1 2		,,
15	,,	,, ,,	,,	,,	Limb complete	10 13 23·86	0 59 2·56			,,

16	T	„ 29	I	Ec. R.	First seen	7 32 27·15	22 18 5·85		22 18 1·8	−0 4·05	„
17	T	July 4	II	Tr. I.	External contact	6 1 8·88	20 46 47·58				„
18	„	„ „	„	„	Bisected	6 2 58·38	20 48 37·08		20 45		„
19	„	„ „	„	„	Internal contact	6 5 37·88	20 51 16·58				„
20	T	„ „	II	Sh. I.	First seen	8 0 10·68	22 45 49·38				„
21	„	„ „	„	„	Shadow bisected (?)	8 1 30·68	22 47 9·38		22 44		„
22	„	„ „	„	„	Internal contact	8 3 59·38	22 49 38·08				„
23	T	„ „	II	Tr. E.	Internal contact	8 29 16·63	23 14 55·33				„
24	„	„ „	„	„	Satellite bisected (?)	8 31 33·13	23 17 11·83		23 19		„
25	„	„ „	„	„	External contact	8 33 37·63	23 19 16·33				„
26	T	„ „	II	Sh. E.	Internal contact	10 24 51·14	1 10 29·84				„
27	„	„ „	„	„	Limb indented	10 26 40·94	1 12 19·64		1 20		„
28	„	„ „	„	„	Limb complete	10 28 57·14	1 14 35·84				„

Remarks.

Ref. No.

1 Very difficult observation.
2 Uncertain; difficult to say when exactly bisected.
3 Uncertain observation; eye very tired.
4 Very exact; first speck of light.
5 Very exact; planet splendidly defined.
6 Very exact.
7, 8, 9 } Good observations.
10, 11, 12 } Good observations.

Ref. No.

13 Good observation.
14 Limb of planet indented by shadow.
16 Seen through cloud, but considered good.
20 Shadow first seen.
21 Limb plainly indented; shadow considered to be bisected.
22 Good observation; limb and shadow sharply defined, but clouds passing over planet.
23, 24, 25 } Very good observations; beautifully defined.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac*.	Apparent Error of *Nautical Almanac*.	Power.
		1876				h m s	h m s	h m s	m s	
29	T	July 5	I	Tr. I.	External contact	8 56 24·00	23 42 2·70			200
30	,,	,, ,,	,,	,,	Bisection (?)	8 58 33·80	23 44 12·50	23 44		,,
31	,,	,, ,,	,,	,,	Internal contact	9 0 28·50	23 46 7·20			,,
32	T	,, ,,	I	Sh. I.	First seen	9 57 12·40	0 42 51·10			,,
33	,,	,, ,,	,,	,,	Limb indented	9 58 43·90	0 44 22·60	0 44		,,
34	,,	,, ,,	,,	,,	Internal contact	10 1 6·10	0 46 44·80			,,
35	R	,, 7	I	Sh. E.	Internal contact	6 34 23·93	21 20 2·63			,,
36	,,	,, ,,	,,	,,	Bisection (?)	6 35 51·43	21 21 30·13	21 26		,,
37	,,	,, ,,	,,	,,	Limb complete	6 37 26·43	21 23 5·13			,,
38	T	,, 12	I	Tr. I.	Internal contact	10 51 7·33	1 36 46·03	1 34		,,
39	R	,, 13	II	Ec. R.	First seen	7 28 15·85	22 13 54·55			,,
40	,,	,, ,,	,,	,,	Quite distinct	7 29 29·85	22 15 8·55	22 16 34·0	+2 39·45	,,
41	,,	,, ,,	,,	,,	Full blaze (?)	7 30 13·85	22 15 52·55			,,
42	R	,, ,,	I	Oc. D.	External contact	8 3 4·80	22 48 43·50			,,
43	,,	,, ,,	,,	,,	Bisection (?)	8 4 47·80	22 50 26·50			,,
44	,,	,, ,,	,,	,,	Disappearance	8 7 27·30	22 53 6·00	22 51		,,
45	R	,, ,,	I	Ec. R.	First seen	11 21 13·50	2 6 52·20			,,
46	,,	,, ,,	,,	,,	Quite distinct	11 23 23·50	2 9 2·20	2 7 15·5	+0 23·30	,,
47	,,	,, ,,	,,	,,	Full blaze (?)	11 24 13·00	2 9 51·70			,,

48	T	„	14	I	Sh. I.	First seen	6 22 58·86	21 8 37·56					125
49	„	„	„	„	„	Bisection (?)	6 23 25·66	21 9 4·36	21 8				„
50	„	„	„	„	„	Internal contact	6 25 22·66	21 11 1·36					„
51	T	„	„	I	Tr. E.	Internal contact	7 26 39·55	22 12 18·25					„
52	„	„	„	„	„	Bisection (?)	7 28 9·25	22 13 47·95	22 14				„
53	„	„	„	„	„	External contact	7 29 56·05	22 15 34·75					„
54	T	„	18	II	Tr. I.	External contact	10 49 16·44	1 34 55·14	1 33				200
55	„	„	„	„	„	Internal contact	10 55 13·74	1 40 52·44					„
56	T	„	20	I	Oc. D.	External contact	9 51 26·89	0 37 5·59	0 41				„
57	„	„	„	„	„	Disappearance	9 58 1·89	0 43 40·59					„
58	T	„	„	II	Ec. R.	First seen	10 5 29·08	0 51 7·78					„
59	„	„	„	„	„	Quite distinct	10 6 21·88	0 52 0·58	0 54	1·4	+2 53·62		„
60	„	„	„	„	„	Full blaze (?)	10 9 26·88	0 55 5·58					„

Remarks.

Ref. No.

29 Good.
31 Very good observation.
32 Shadow first seen.
33 Shadow bisected.
34 Limb complete.
36 Limb of planet indented.
37 Limb complete; external contact.
38 Very good observation; external contact lost; too late.
42, 43 Good observations; planet and satellite splendidly defined.
44 The satellite was seen for some seconds as a very fine point of light and suddenly disappeared at time noted, which was considered very exact.
45 Very good observation.
47 About full blaze.
48 A little way on limb of planet; planet badly defined throughout this phenomenon; could use only power 125.
51, 52, 53 Very badly defined and unsteady.
54 Very unsteady; satellite continually jumping off and on planet.
55 Very good observation.
58 First glimmer; very exact; thin clouds occasionally passing over planet; observation considered good.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac*.	Apparent Error of *Nautical Almanac*.	Power.
		1876				h m s	h m s	h m s	m s	
61	T	July 21	I	Tr. I.	External contact	7 5 10·70	21 50 49·40			200
62	,,	,, ,,	,,	,,	Bisection (?)	7 7 0·70	21 52 39·40	21 52		,,
63	,,	,, ,,	,,	,,	Internal contact	7 9 21·70	21 55 0·40			,,
64	T	,, ,,	I	Sh. I.	First seen	8 17 39·58	23 3 18·28			,,
65	,,	,, ,,	,,	,,	Bisection (?)	8 18 41·58	23 4 20·28	23 3		,,
66	,,	,, ,,	,,	,,	Internal contact	8 20 38·58	23 6 17·28			,,
67	T	,, ,,	I	Tr. E.	Internal contact	9 13 37·50	23 59 16·20			,,
68	,,	,, ,,	,,	,,	Bisection (?)	9 16 43·50	0 2 22·20	0 5		,,
69	,,	,, ,,	,,	,,	External contact	9 18 44·50	0 4 23·20			,,
70	T	,, ,,	I	Sh. E.	Internal contact	10 22 16·38	1 7 55·08			,,
71	,,	,, ,,	,,	,,	Bisection (?)	10 24 16·88	1 9 55·58	1 16		,,
72	,,	,, ,,	,,	,,	Limb complete	10 26 18·88	1 11 57·58			,,
73	T	,, 28	I	Tr. I.	External contact	8 56 34·47	23 42 13·17			,,
74	,,	,, ,,	,,	,,	Bisection (?)	8 58 44·77	23 44 23·47	23 45		,,
75	,,	,, ,,	,,	,,	Internal contact	9 1 12·27	23 46 50·97			,,
76	T	,, 30	I	Sh. E.	Internal contact	6 46 34·93	21 32 13·63			,,
77	,,	,, ,,	,,	,,	Bisection (?)	6 48 54·93	21 34 33·63	21 40		,,
78	,,	,, ,,	,,	,,	Limb complete	6 50 54·93	21 36 33·63			,,
79	T	Aug. 1	III	Tr. I.	External contact	9 6 51·63	23 52 30·33			,,
80	,,	,, ,,	,,	,,	Bisection (?)	9 9 43·13	23 55 21·83	0 1		,,
81	,,	,, ,,	,,	,,	Internal contact	9 17 5·93	0 2 44·63			,,

82	R	„	12	III	Oc. R.	External contact	5	19	30·26	20	5	8·96	20 10	„
83	R	„	„	II	Tr. I.	External contact	7	36	23·00	22	22	1·70		„
84	„	„	„	„	„	Bisection	7	37	50·00	22	23	28·70	22 17	„
85	„	„	„	„	„	Internal contact	7	40	38·50	22	26	17·20		„
86	R	„	„	III	Ec. D.	Satellite just visible	8	39	29·86	23	25	8·56		„
87	„	„	„	„	„	Disappearance	8	39	57·86	23	25	36·56	23 20 33·0	−5 3·56 „
88	R	„	„	I	Oc. D.	External contact	9	59	36·72	0	45	15·42		„
89	„	„	„	„	„	Bisection (?)	10	1	8·72	0	46	47·42	0 47	„
90	„	„	„	„	„	Disappearance	10	3	58·72	0	49	37·42		„
91	R	„	„	II	Tr. E.	Internal contact	10	8	20·70	0	53	59·40		„
92	„	„	„	„	„	Bisection (?)	10	9	17·70	0	54	56·40	0 54	„
93	„	„	„	„	„	External contact	10	9	54·70	0	55	33·40		„
94	R	„	„	II	Sh. I.	First seen	10	10	4·20	0	55	42·90		„
95	„	„	„	„	„	Limb indented	10	11	54·70	0	57	33·40	0 54	„
96	„	„	„	„	„	Internal contact	10	12	4·70	0	57	43·40		„

Remarks.

Ref. No.

63 Good observation.
66 Limb complete.
67 May be a little early.
69 Very exact; good observation.
70, 71, 72 Limb very unsteady and only well defined occasionally, rendering observation extremely difficult.
73 Good observation.
75 Good observation.

Ref. No.

78 Last seen; limb complete; good; planet's limb very sharply defined.
82 Rather late; much before expected time; when seen the whole of the satellite was visible.
87 Last seen; good observation.
90 For several seconds before disappearance the satellite seemed to be visible inside limb of planet, as if projected on planet.
94 The limb a little indented.
96 Limb complete; may be a little late.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac*.	Apparent Error of *Nautical Almanac*.	Power.
		1876				h m s	h m s	h m s	m s	
97	R	Aug. 12	III	Ec. R.	First seen	10 21 0·68	1 6 39·38			200
98	,,	,, ,,	,,	,,	Quite distinct	10 22 54·18	1 8 32·88	1 10 47·4	+4 8·02	,,
99	,,	,, ,,	,,	,,	Full blaze (?)	10 23 55·68	1 9 34·38			,,
100	R	,, 13	I	Tr. I.	External contact	7 12 20·80	21 57 59·50			,,
101	,,	,, ,,	,,	,,	Bisection (?)	7 14 46·80	22 0 25·50	22 1		,,
102	,,	,, ,,	,,	,,	Internal contact	7 16 59·80	22 2 38·50			,,
103	R	,, ,,	I	Sh. I.	First seen	8 32 23·65	23 18 2·35			,,
104	,,	,, ,,	,,	,,	Bisection (?)	8 33 8·65	23 18 47·35	23 18		,,
105	,,	,, ,,	,,	,,	Limb complete	8 33 56·65	23 19 35·35			,,
106	R	,, ,,	I	Tr. E.	Internal contact	9 25 41·52	0 11 20·22			,,
107	,,	,, ,,	,,	,,	Bisection (?)	9 27 25·52	0 13 4·22	0 14		,,
108	,,	,, ,,	,,	,,	External contact	9 28 13·52	0 13 52·22			,,
109	R	,, 14	II	Ec. R.	First seen	7 17 6·95	22 2 45·65			,,
110	,,	,, ,,	,,	,,	Quite distinct	7 17 33·95	22 3 12·65	22 5 19·1	+2 33·45	,,
111	,,	,, ,,	,,	,,	Full blaze (?)	7 18 48·95	22 4 27·65			,,
112	R	,, ,,	I	Ec. R.	First seen	7 57 21·87	22 43 0·57			
113	,,	,, ,,	,,	,,	Quite distinct	7 57 58·87	22 43 37·57	22 43 31·6	+0 31·03	,,
114	,,	,, ,,	,,	,,	Full blaze (?)	7 58 58·87	22 44 37·57			,,
115	R	,, 19	III	Oc. D.	External contact	7 8 16·80	21 53 55·50			,
116	,,	,, ,,	,,	,,	Bisection (?)	7 12 40·30	21 58 19·00	21 57		,,
117	,,	,, ,,	,,	,,	Disappearance	7 19 46·30	22 5 25·00			,,

118	R	„	„	III	Oc. R.	First seen	9	17	35·05	0 3 13·75		„
119	„	„	„	„	„	Bisection (?)	9	20	47·55	0 6 26·25	0 10	„
120	„	„	„	„	„	External contact (?)	9	28	15·55	0 13 54·25		„
121	T	„	20	I	Tr. I.	External contact	9	8	15·30	23 53 54·00		„
122	„	„	„	„	„	Bisection	9	10	20·30	23 55 59·00	23 56	„
123	„	„	„	„	„	Internal contact	9	12	37·30	23 58 16·00		„
124	T	„	21	I	Oc. D.	External contact	6	23	52·24	21 9 30·94		„
125	„	„	„	„	„	Bisection (?)	6	25	41·54	21 11 20·24	21 11	„
126	„	„	„	„	„	Disappearance	6	27	57·54	21 13 36·24		„

Remarks.

Ref. No.

97 Very good observation; first seen as a minute speck of light.

100, 101, 102 Good observations; well defined.

103 Very good.

108 Could not obtain egress of shadow; last seen about twice its diameter from limb of planet; power 125.

109 Very good observation; suddenly appearing as a very minute speck of light.

112 Good observation; suddenly appearing as a very minute speck of light.

115 Very steady and well defined.

116 Appeared as a well-defined nipple protruding from planet; very steady and well defined.

Ref. No.

117 Very good; steady and well defined; suddenly disappearing; satellite appeared as if projected on planet, and in internal contact a full minute before its final disappearance.

118 First seen as a fine point of light, a little outside limb of planet; throughout this phenomenon, which was very good and well defined, there was a dark line or sensible space between satellite and limb of planet.

121, 122, 123 Very good and well defined.

124, 125, 126 Very good; steady and well defined; after bisection the satellite was seen as if projected on limb of planet.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac*.	Apparent Error of *Nautical Almanac*.	Power.
		1876				h m s	h m s	h m s	m s	
127	T	Aug. 21	II	Oc. R.	First seen	7 18 55·43	22 4 34·13			200
128	,,	,, ,,	,,	,,	Bisection (?)	7 19 51·93	22 5 30·63	22 8	-	,,
129	,,	,, ,,	,,	,,	External contact (?)	7 22 40·43	22 8 19·13			,,
130	T	,, ,,	II	Ec. D.	Disappearance	7 23 55·42	22 9 34·12	22 8 54·3	−0 39·82	,,
131	T	,, ,,	I	Ec. R.	First seen	9 52 23·16	0 38 1·86			125
132	,,	,, ,,	,,	,,	Quite distinct	9 53 52·16	0 39 30·86	0 38 17·3	+0 15·44	,,
133	,,	,, ,,	,,	,,	Full blaze (?)	9 55 54·16	0 41 32·86			,,
134	T	,, ,,	II	Ec. R.	First seen	9 55 19·16	0 40 57·86			,,
135	,,	,, ,,	,,	,,	Quite distinct	9 57 21·15	0 42 59·85			,,
136	,,	,, ,,	,,	,,	I and II Satellites equally bright	9 58 1·15	0 43 39·85	0 43 5·9	+2 8·04	,,
137	,,	,, ,,	,,	,,	Full blaze (?)	9 59 49·15	0 45 27·85			,,
138	R	,, 22	I	Sh. E.	Internal contact	7 2 26·62	21 48 5·32			200
139	,,	,, ,,	,,	,,	Bisection (?)	7 3 41·62	21 49 20·32	21 55	-	,,
140	,,	,, ,,	,,	,,	Limb complete	7 6 1·62	21 51 40·32			,,
141	T	,, 28	II	Oc. D.	External contact	7 20 55·60	22 6 34·30			,,
142	,,	,, ,,	,,	,,	Bisection (?)	7 22 29·30	22 8 8·00	22 11		,,
143	,,	,, ,,	,,	,,		7 24 5·60	22 9 44·30			,,
144	,,	,, ,,	,,	,,	Disappearance	7 25 59·60	22 11 38·30			,,

145	T	„	„	I	Oc. D.	External contact	8	19	19·47	23	4	58·17	„
146	„	„	„	„	„	Bisection (?)	8	20	56·97	23	6	35·67	23 7 „
147	„	„	„	„	„	Disappearance	8	23	38·97	23	9	17·67	„
148	T	„	29	I	Sh. I.	First seen	6	51	57·52	21	37	36·22	„
149	„	„	„	„	„	Internal contact	6	54	45·52	21	40	24·22	21 38 „
150	T	„	„	I	Tr. E.	Internal contact	7	45	15·90	22	30	54·60	„
151	„	„	„	„	„	Bisection (?)	7	46	56·90	22	32	35·60	22 35 „
152	„	„	„	„	„	External contact	7	48	59·90	22	34	38·60	„
153	T	„	30	I	Ec. R.	First seen	6	15	36·57	21	1	15·27	„
154	„	„	„	„	„	Quite distinct	6	16	17·07	21	1	55·77	21 1 44·9 +0 29·63 „
155	„	„	„	„	„	Full blaze (?)	6	19	7·07	21	4	45·77	„

Remarks.

Ref. No.

127 Quite a minute late (?) emerging at a sensible distance from limb or edge of planet.

128 Immediately after this, the satellite commenced to diminish in brightness; entering shadow.

129 Supposed external contact, but satellite becoming very dim, as it entered shadow immediately after reappearance.

130 Very exact; close to limb of planet, to which it appeared to cling as it diminished in brightness.

134 The second satellite reappeared before the first was full blaze.

136 The two satellites equal in brightness, and about $1\frac{1}{2}$ to 2 diameters apart, appearing as a pretty double star; these two phenomena were very good observations, steady and well defined.

Ref. No.

138 Not very good; limb very unsteady.

139 Fair observation.

140 Supposed external contact.

143 Satellite quite distinctly seen, as if projected on planet.

144 Last seen.

145 Not very good; hazy, and thin cloud over sky; planet and satellite unsteady; good only in glimpses.

148 When first seen nearly bisected.

149 A very good observation; planet fairly well defined.

152 A very good observation; could not make out the shadow at egress.

153 Very good.

Reference No.	Observer.	Day of Observation. 1876	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time. h m s	Corresponding Greenwich Mean Time. h m s	Greenwich Mean Time by *Nautical Almanac.* h m s	Apparent Error of *Nautical Almanac.* m s	Power.
156	T	Aug. 30	III	Sh. I.	First seen	6 18 54·57	21 4 33·27			200
157	,,	,, ,,	,,	,,	Limb indented	6 25 57·54	21 11 36·24	21 5		,,
158	,,	,, ,,	,,	,,	Internal contact	6 27 47·04	21 13 25·74			,,
159	T	,, ,,	II	Sh. E.	Internal contact	7 3 17·95	21 48 56·65			,,
160	,,	,, ,,	,,	,,	Limb broken	7 4 36·95	21 50 15·65	21 58		,,
161	,,	,, ,,	,,	,,	Bisection (?)	7 5 43·95	21 51 22·65			,,
162	,,	,, ,,	,,	,,	Limb complete	7 7 21·95	21 53 0·65			,,
163	T	,, ,,	III	Sh. E.	Internal contact	8 3 52·80	22 49 31·50			,,
164	,,	,, ,,	,,	,,	Limb broken	8 5 47·80	22 51 26·50			,,
165	,,	,, ,,	,,	,,	Bisection (?)	8 9 26·80	22 55 5·50	23 10		,,
166	,,	,, ,,	,,	,,	Limb indented	8 13 28·80	22 59 7·50			,,
167	,,	,, ,,	,,	,,	Limb indented	8 14 52·30	23 0 31·00			,,
168	,,	,, ,,	,,	,,	Limb complete	8 17 5·80	23 2 44·50			,,
169	R	Sept. 5	I	Tr. I.	External contact	7 32 30·97	22 18 9·67			,,
170	,,	,, ,,	,,	,,	Bisection (?)	7 33 43·97	22 19 22·67	22 20		,,
171	,,	,, ,,	,,	,,	Internal contact	7 35 19·47	22 20 58·17			,,
172	T	,, 6	II	Sh. I.	First seen	7 11 42·30	21 57 21·00	21 55		,,
173	,,	,, ,,	,,	,,	Internal contact	7 14 54·30	22 0 33·00			,,
174	T	,, ,,	II	Tr. E.	Internal contact	7 15 48·80	22 1 27·50			,,
175	,,	,, ,,	,,	,,	Bisection (?)	7 19 20·30	22 4 59·00	22 4		,,
176	,,	,, ,,	,,	,,	External contact	7 22 5·29	22 7 43·99			,,

177	T	„	„	III	Tr. E.	Internal contact	7 21 13·79	22 6 52·49					„
178	„	„	„	„	„	Bisection (?)	7 25 39·29	22 11 17·99	22 21				„
179	„	„	„	„	„	External contact	7 33 30·28	22 19 8·98					„
180	T	„	„	I	Ec. R.	First seen	8 10 22·20	22 56 0·90					„
181	„	„	„	„	„	Quite distinct	8 10 59·20	22 56 37·90	22 56 29·6		+0 28·70		„
182	„	„	„	„	„	Full blaze (?)	8 14 14·20	22 59 52·90					„
183	R	„	13	II	Tr. I.	External contact	7 24 42·05	22 10 20·75					„
184	„	„	„	„	„	Bisection (?)	7 26 50·05	22 12 28·75	22 7				„
185	„	„	„	„	„	Internal contact	7 20 2·55	22 15 41·25					„
186	T	„	17	III	Ec. R.	First seen	6 18 30·32	21 4 9·02	21 8 48·4		+4 39·38		125
187	„	„	„	„	„	Full blaze (?)	6 28 41·61	21 14 20·31					„

Remarks.

Ref. No.

156 When first seen limb sensibly indented, as I was watching for full blaze of first satellite.
158 Limb complete, definition excellent.
162 Limb complete; throughout this observation, which was very good, the planet being well defined, the shadow of III satellite was traversing the polar regions of *Jupiter* in high north latitude, and appeared very large and distinct; slightly but sensibly oval.
163 Tangential and well defined in glimpses.
164 Limb sensibly broken.
167 Limb still indented.
168 Last seen; limb complete; considered very good throughout this phenomenon.
169, 170, 171 Good; very steady and well defined throughout.
172 Steady and well defined, but at times a boiling motion on limb; well on when first seen.
173 to 179 Steady and well defined, but at times a boiling motion on limb.
174 Good.
176 Good; satellite faint, lying on a bright cloud belt.
177 A little late.
179 Good observation.
180 Very good; first seen as a minute speck of light.
183, 184, 185 Unsteady, limb boiling.
186 Very good; first seen as a minute speck of light.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac*.	Apparent Error of *Nautical Almanac*.	Power.
		1876				h m s	h m s	h m s	m s	
188	T	Sept. 20	I	Oc. D.	External contact	8 40 14·00	23 25 52·70			125
189	,,	,, ,,	,,	,,	Bisection (?)	8 41 41·00	23 27 19·70	23 29		,,
190	,,	,, ,,	,,	,,	Disappearance	8 43 55·00	23 29 33·70			,,
191	R	,, 22	I	Ec. R.	First seen	6 28 33·97	21 14 12·67			200
192	,,	,, ,,	,,	,,	Quite distinct	6 29 8·97	21 14 47·67	21 14 37·3	+0 24·63	,,
193	,,	,, ,,	,,	,,	Full blaze (?)	6 30 33·97	21 16 12·67			,,
194	T	,, ,,	II	Ec. R.	First seen	9 45 30·55	0 31 9·25			125
195	,,	,, ,,	,,	,,	Quite distinct	9 46 51·55	0 32 30·25	0 33 18·7	+2 9·45	,,
196	,,	,, ,,	,,	,,	Full blaze (?)	9 50 8·55	0 35 47·25			,,
197	T	,, 24	III	Oc. R.	External contact	6 16 31·92	21 2 10·62	21 2		200
198	T	,, ,,	III	Ec. D.	Disappearance	8 32 50·02	23 18 28·72	23 13 51·1	−4 37·62	125
199	T	Oct. 7	I	Tr. E.	Internal contact	6 39 54·70	21 25 33·40			200
200	,,	,, ,,	,,	,,	Bisection (?)	6 41 35·20	21 27 13·90	21 30		,,
201	,,	,, ,,	,,	,,	External contact	6 43 24·20	21 29 2·90			,,
202	T	,, 8	II	Tr. E.	Internal contact	7 29 28·45	22 15 7·15			,,
203	,,	,, ,,	,,	,,	Bisection (?)	7 33 13·45	22 18 52·15	22 20		,,
204	,,	,, ,,	,,	,,	External contact	7 36 18·45	22 21 57·15			,,
205	T	,, 14	I	Tr. I.	External contact	6 29 3·04	21 14 41·74			,,
206	,,	,, ,,	,,	,,	Bisection (?)	6 30 52·54	21 16 31·24	21 17		,,
207	,,	,, ,,	,,	,,	Internal contact	6 32 57·54	21 18 36·24			,,

208	T	„	„	I	Sh. I.	First seen	7 21 50·98	22 7 29·68	22 6			125
209	„	„	„	„	„	Internal contact	7 26 2·98	22 11 41·68				„
210	T	„	15	I	Ec. R.	First seen	6 41 6·36	21 26 45·06	21 27 8·6	+0 23·54		„
211	„	„	„	„	„	Full blaze (?)	6 44 7·36	21 30 46·06				„
212	T	„	„	II	Tr. I.	External contact	7 39 22·26	22 25 0·96	22 27			200
213	„	„	„	„	„	Bisection (?)	7 42 42·26	22 28 20·96				„
214	„	„	„	„	„	Internal contact	7 45 59·26	22 31 37·96				„

Remarks.

Ref. No.
188, 189, 190 } Badly defined; edges of planet woolly and ragged.
191 First seen as a minute speck of light; very faint; considered good.
192, 193 } Considered good.
194, 195, 196 } Good.
197 Too late for first appearance.
198 Very exact.
199, 200, 201 } Very good; fairly steady.

Ref. No.
202, 203, 204 } Considered good; planet well defined, but limb rather unsteady.
205, 206, 207 } Very good.
208, 209 } Both worthless; limb too unsteady and ill defined.
210, 211 } Wonderfully beautiful view of planet; splendidly defined.
211 As bright as No. II close by, the two making a pretty double star.
212, 213, 214 } Good, but not so well defined as at the previous observation.

Notes on Physical Appearance of Planet, 1876.

June 28, 8.30 P.M.—From about 10° north latitude to about 20° to 25° south latitude the planet was of a bright salmon colour, varied by streaks and patches of cumulus-looking clouds, more especially in the southern portion. Over each temperate zone there was a very decided belt of bright cumulus cloud, between which and the poles the surface was of a greyish green or olive green colour, mottled with streaks and patches of cloud. The outlines of the bright cloud belts were very marked and well defined.—R.

July 30, 6.35.—On either side of the equator, reaching to latitude 15° ±, the planet was of a pale salmon colour, mottled with small detached cumulus or cirro-cumulus looking clouds and narrow white parallel streaks. The southern margin of this band was bounded by a long bank of cumulus cloud, reaching diagonally from latitude 15° or 20° on east limb to latitude 35° ± on west limb, dividing into two branches on west side of the planet's polar diameter. From the poles to about latitude 60° the planet was of a dull greyish green, varied with a few bright belts.—T.

August 29, 7.30.—From about 15° north latitude to 15° south latitude the planet was of a salmon colour, over the southern half of which were scattered clouds, between which the salmon coloured ground was visible. Between latitude 15° and 25° north there was a very bright belt of cloud, having its northern edge very marked and well defined. Between this and the north pole there were less brilliant cloud belts, overlying a greyish green ground. Scattered clouds around pole.

The scattered clouds south of the equator had a remarkable dark band, which seemed to be a rift in the clouds, south of which the clouds had a dull appearance. In the temperate regions of the southern hemisphere, as also in the northern, there was the greyish green colour seen between scattered clouds; and round the south pole was of a light greyish colour.

During this observation it was particularly remarked that in the northern hemisphere the north edge of belts and clouds was the most marked and well defined, which also applied to the south sides of same in the southern hemisphere.—R.

Oct. 15, 6.42.—Wonderfully beautiful view of planet, definition splendid. Over the equatoreal regions, for a space of about 15° or 20° on either side of the equator, were delicate streaks of cloud, some being knotted like small cumulus or cirro-cumulus resting on a background of a deep salmon tint. Towards the south a bank cumulus, having its horizontal base towards the equator, reached across the planet. This bright band, which had the roundish outline of cumulus, reached nearer to the south pole than usual, or to within about 40° of the pole, varied by dark spaces here and there. The north pole was of the usual greyish green tint, bounded by a broad bright band over the temperate or middle zone.—T.

The Observatory, Adelaide,
1876, *November* 30.

Ephemeris for Physical Observations of Mars, 1877.

By Mr. A. Marth.

Greenwich Noon. 1877.	Angle of Position of ♂'s Axis.	Areographical Western Long. of the Centre of ♂'s Disk.	Diff.	Latitude	Diameter.	Amount and Position of Greatest Defect of Illumination.		Areocentric Angle between Earth and Sun.
	°	°	°	°	″	″	°	°
June 9	348·55	269·77		−24·19	12·76	1·72	249·91	43·09
			700·70					
11	347·85	250·47		24·27	13·00	1·74	249·80	42·91
			·71					
13	347·17	231·18		24·33	13·24	1·75	249·72	42·70
			·73					
15	346·50	211·91		24·38	13·49	1·77	249·65	42·47
			·76					
17	345·85	192·67		24·41	13·74	1·78	249·59	42·22
			·77					
19	345·22	173·44		24·44	14·00	1·79	249·55	41·94
			·80					
21	344·60	154·24		24·45	14·27	1·80	249·53	41·64
			·82					
23	344·00	135·06		24·45	14·54	1·81	249·52	41·31
			·84					
25	343·42	115·90		24·44	14·82	1·81	249·53	40·96
			·88					
27	342·87	96·78		24·42	15·11	1·82	249·55	40·58
			·90					
29	342·33	77·68		24·39	15·40	1·82	249·59	40·17
			·93					
July 1	341·81	58·61		−24·35	15·70	1·81	249·65	39·74
			700·97					
3	341·32	39·58		24·30	16·01	1·81	249·73	39·27
			701·00					
5	340·85	20·58		24·24	16·33	1·80	249·83	38·77
			·04					
7	340·41	1·62		24·18	16·65	1·78	249·95	38·23
			·07					
9	339·99	342·69		24·11	16·97	1·77	250·08	37·65
			·12					
11	339·60	323·81		24·03	17·31	1·75	250·24	37·04
			·16					
13	339·23	304·97		23·95	17·65	1·72	250·42	36·39
			·20					
15	338·89	286·17		23·68	17·99	1·69	250·63	35·69
			·25					
17	338·57	267·42		23·77	18·34	1·65	250·86	34·96
			·30					
19	338·29	248·72		23·68	18·69	1·61	251·12	34·18
			·34					
21	338·03	230·06		23·58	19·05	1·57	251·40	33·36
			·40					
23	337·80	211·46		23·49	19·41	1·52	251·72	32·49
			·44					
25	337·60	192·90		23·39	19·77	1·46	252·08	31·57
			·50					

Greenwich Noon. 1877.	Angle of Position of ♂'s Axis.	Areographical Western Long. of the Centre of ♂'s Disk.	Diff.	Latitude	Diameter.	Amount and Position of Greatest Defect of Illumination.		Areocentric Angle between Earth and Sun.
	°	°	°	°	″	″	°	°
July 27	337·43	174·40		−23·29	20·14	1·40	252·47	30·61
			·55					
29	337·29	155·95		23·19	20·50	1·34	252·90	29·60
			·61					
31	337·18	137·56		23·10	20·87	1·27	253·38	28·54
			·66					
Aug. 2	337·10	119·22		−23·01	21·23	1·19	253·92	27·42
			701·73					
4	337·05	100·95		22·92	21·58	1·11	254·52	26·25
			·78					
6	337·04	82·73		22·84	21·93	1·03	255·19	25·03
			·84					
8	337·06	64·57		22·76	22·27	0·94	255·95	23·76
			·90					
10	337·11	46·47		22·70	22·60	0·86	256·79	22·44
			701·96					
12	337·19	28·43		22·63	22·91	0·77	257·77	21·06
			702·01					
14	337·30	0·44		22·58	23·21	0·68	258·92	19·64
			·06					
16	337·44	352·50		22·52	23·49	0·59	260·25	18·18
			·10					
18	337·61	334·62		22·48	23·75	0·50	261·82	16·68
			·16					
20	337·81	316·78		22·44	23·98	0·42	263·70	15·15
			·21					
22	338·04	298·99		22·42	24·19	0·34	266·01	13·60
			·24					
24	338·29	281·23		22·40	24·37	0·27	268·92	12·03
			·28					
26	338·56	263·51		22·39	24·52	0·21	272·70	10·46
			·32					
28	338·85	245·83		22·40	24·63	0·15	277·78	8·92
			·34					
30	339·16	223·17		22·41	24·71	0·10	284·9	7·45
			·35					
Sept. 1	339·48	210·52		−22·43	24·76	0·07	295·2	6·13
			702·37					
3	339·81	192·89		22·46	24·76	0·05	310·5	5·08
			·38					
5	340·15	175·27		22·49	24·73	0·04	331·4	4·52
			·37					
7	340·50	157·64		22·54	24·66	0·04	354·2	4·64
			·37					
9	340·84	140·01		22·60	24·56	0·05	13·2	5·39
			·35					
11	341·17	122·36		22·67	24·41	0·08	26·5	6·55
			·33					
13	341·50	104·69		22·74	24·23	0·12	35·5	7·92
			·30					
15	341·81	86·99		22·83	24·02	0·16	41·80	9·39
			·27					
17	342·10	69·26		22·92	23·78	0·21	46·33	10·91
			·23					

Greenwich Noon. 1877.	Angle of Position of ♂'s Axis.	Areographical Western Long. of the Centre of ♂'s Disk.	Diff.	Areographical Latitude of ♂'s Disk.	Diameter.	Amount and Position of Greatest Defect of Illumination.		Areocentric Angle between Earth and Sun.
	°	°	°	°	″	″	°	°
Sept. 19	342·38	51·49		−23·02	23·52	0·27	49·74	12·44
			·19					
21	342·63	33·68		23·13	23·22	0·34	52·39	13·97
			·14					
23	342·86	15·82		23·25	22·91	0·41	54·51	15·46
			·10					
25	343·06	357·92		23·38	22·57	0·49	56·23	16·93
			702·04					
27	343·23	339 96		23·51	22·22	0·57	57·67	18·37
			701·98					
29	343·37	321·94		23·65	21·85	0·64	58·87	19·76
			·93					
Oct. 1	343·47	303·87		−23·80	21·47	0·72	59·90	21·10
			701·88					
3	343·54	285·75		23·95	21·09	0·80	60·78	22·40
			·82					
5	343·58	267·57		24·11	20·69	0·87	61·54	23·65
			·75					
7	343·59	249·32		24·27	20·29	0·94	62·20	24·84
			·70					
9	343 56	231·02		24·44	19·89	1·01	62·78	25·98
			·64					
11	343·49	212·66		24·61	19·49	1·07	63·28	27·07
			·58					
13	343·39	194·24		24·78	19·09	1·13	63·72	28·11
			·52					
15	343·26	175·76		24·96	18 69	1·18	64·11	29·10
			·47					
17	343·10	157·23		25·14	18·29	1·23	64 44	30·03
			·41					
19	342·90	138·64		25·32	17·90	1·27	64·74	30·92
			·36					
21	342·67	120·00		25·50	17·52	1·31	64·99	31·76
			·31					
23	342·41	101·31		25·68	17·14	1·35	65·21	32·56
			·26					
25	342·13	82·57		25·85	16·77	1·38	65·41	33·31
			·21					
27	341·82	63·78		26·03	16·40	1·40	65·57	34·01
			·17					
29	341·49	44·95		26·20	16·04	1·42	65·72	34·68
			·12					
31	341 13	26·07		26·37	15·69	1·44	65·84	35·31
			·08					
Nov. 2	340·74	7·15		−26·53	15·35	1·46	65·94	35·89
			701·04					
4	340·34	348·19		26·69	15·02	1·47	66·03	36·44
			700·99					
6	339·92	329·18		26·84	14·70	1·48	66·10	36·96
			·96					
8	339·47	310·14		26·99	14·38	1·48	66·16	37·44
			·92					
10	339·01	291·06		27·12	14·07	1·48	66·21	37·88
			·89					

Greenwich Noon. 1877.	Angle of Position of ♂'s Axis.	Areographical Western Long. of the Centre of ♂'s Disk.	Diff.	Latitude	Diameter.	Amount and Position of Greatest Defect of Illumination.		Areocentric Angle between Earth and Sun.
	°	°	°	°	″	″	°	°
Nov. 12	338·53	271·95		−27·25	13·77	1·48	66·25	38·29
			·86					
14	338·04	252·81		27·37	13·48	1·48	66·28	38·68
			·82					
16	337·54	233·63		27·49	13·20	1·47	66·31	39·03
			·79					
18	337·02	214·42		27·59	12·92	1·47	66·33	39·35
			·76					
20	336·49	195·18		27·68	12·66	1·46	66·35	39·65
			·74					
22	335·95	175·92		27·76	12·40	1·45	66·36	39·93
			·71					
24	335·40	156·63		27·84	12·14	1·43	66·37	40·18
			·69					
26	334·85	137·32		27·89	11·90	1·42	66·38	40·41
			·67					
28	334·29	117·99		27·94	11·66	1·40	66·39	40·61
			·64					
30	333·73	98·63		27·98	11·43	1·39	66·40	40·79
			·62					
Dec. 2	333·16	79·25		−28·00	11·21	1·37	66·41	40·96
			700·61					
4	332·59	59·86		28·01	10·99	1·35	66·42	41·10
			·59					
6	332·02	40·45		28·00	10·78	1·34	66·43	41·22
			·57					
8	331·45	21·02		27·98	10·58	1·32	66·45	41·33
			·55					
10	330·88	1·57		27·95	10·38	1·30	66·47	41·41
			·54					
12	330·32	342·11		27·91	10·18	1·28	66·49	41·48
			700·54					
14	329·75	322·65		−27·85	10·00	1·26	66·52	41·54

1877 April 24 Autumnal Equinox of *Mars*' northern hemisphere.
1877 Sept. 18 Winter Solstice ,, ,, ,,
1878 Feb. 22 Spring Equinox ,, ,, ,,

The following list gives the areographic longitude and latitude of the centre of the disk of *Mars*, and also its apparent diameter, for the times of a number of sketches made during the oppositions of 1862 and 1864. Not to make it too lengthy, it is confined to the sketches of—

Dawes (8 sketches in vol. 25 of the *Monthly Notices*, p. 225).
Von Franzenau (6 in vol. 51 of the *Sitzungsberichte* of the Vienna Academy, p. 509).
Harkness (2 in the Washington Observations of 1862, p. 152).
Kaiser (2 plates with respectively 9 and 12 sketches in vol. 3 of the *Annalen der Sternwarte in Leiden*).
Lassell (2 plates with 24 sketches in vol. 32 of the *Memoirs of the Royal Astronomical Society*).
Lockyer (4 plates with 16 sketches in the same volume).
Rosse (6 sketches made at Lord Rosse's Observatory, published in the same volume).
Secchi (8 sketches made by Secchi or Cappelletti, and published in Tav. V. p. 76 of *Memorie del Osservatorio d. Coll. Rom. Nuova Serie. Roma*, 1863).

The sketches are arranged in the order of the longitudes of their central meridians.

Areographical Long. of the Centre of the Disk.	Areographical Lat. of the Centre of the Disk.	Diameter.		Times assigned to the Sketches.	
°	°	″			
1·1	−21·2	22·8	Lassell 3	1862 Sept. 22·44	Gr.
5·7	−25·2	19·8	„ 16	Oct. 27·31	„
6·5	− 2·2	17·0	Franzenau 2	64 Nov. 10 9h 30m	Vienna.
12·1	−22·1	23·0	Harkness 2	62 Sept. 30 11h	Washgt.
12·1	−21·3	22·9	Lockyer I. 2	23 11h 55m	Gr.
18·8	−21·0	22·7	Lassell 2	20·44	„
19·7	−25·0	20·2	Secchi 4	Oct. 25 8h	Rome.
23·8	− 2·4	17·0	Kaiser II. 2	64 Nov. 11 10h 30m	Leiden.
24·0	− 3·0	17·2	Dawes 10	14 12h 0m	Gr.
24·3	− 1·9	16·8	Franzenau I.	8 9h 30m	Vienna.
26·7	−21·3	22·9	Lockyer I. 3	62 Sept. 23 12h 55m	Gr.
28·2	− 2·1	16·9	Kaiser II. 1	64 Nov. 9 9h 35m	Leiden.
29·0	−25·1	20·0	Secchi 5	62 Oct. 26 9h 15m	Rome.
39·5	−25·3	19·5	Rosse 5	29 1h	Sid. T. Birr C.
45·0	−26·5	13·4	Kaiser I. 7	Dec. 2 8h 35m	Leiden.
48·2	−25·0	20·2	Lassell 15	Oct. 25·38	Gr.
49·1	− 2·6	17·1	Dawes 12	64 Nov. 12 12h 30m	„
49·4	−20·7	22·5	Lockyer I. 4	62 Sept. 17 10h 50m	„
49·8	− 9·7	15·7	Kaiser II. 7	64 Dec. 18 10h 0m	Leiden.
? 59	−20·7	22·5	Lockyer II. 1	62 Sept. 17 ?	
60·5	− 2·3	17·0	Dawes 13	64 Nov. 10 12h 6m	Gr.
69·2	−24·8	20·5	Lassell 14	62 Oct. 23·39	„
75·1	−10·1	11·2	Dawes 15	65 Jan. 21 8h	„
77·0	−24·6	20·9	Lassell 13	62 Oct. 25·36	„
80·8	−20·5	22·1	„ 1	Sept. 13·439	„
83·8	− 9·3	16·0	Kaiser II. 8	64 Dec. 15 10h 30m	Leiden.
85·3	−24·2	21·4	Secchi 3	62 Oct. 18 8h 13m	Rome.
86·2	−20·6	22·4	Rosse 3	Sept. 16 23h 55m	Sid. T. Birr C.
86·4	−24·9	20·4	Kaiser I. 3	Oct. 24 11h 25m	Leiden.
94·3	−24·2	21·4	Lockyer II. 2	Oct. 18 8h	Gr.
113·5	−20·5	22·2	Rosse 2	Sept. 14 0h 26 (assuming the time to be 0h 26m instead of 6h 26m)	Sid. T. Birr C.
118·8	−26·5	14·8	Kaiser I. 6	Nov. 23 7h 50m	Leiden.
119·8	−26·5	15·0	Lassell 22	22·29	Gr.
123·2	− 8·4	16·6	Kaiser II. 6	64 Dec. 10 10h 10m	Leiden.
127·5	− 1·2	16·4	Dawes 2	Nov. 3 12h 24m	Gr.
128·3	−24·2	21·4	Lassell 12	62 Oct. 18·43	„

Areographical Long. and Lat. of the Centre of the Disk.		Diameter.		Times assigned to the Sketches.	
°	°	″			
137·2	−24·1	21·5	Lassell 11	17·43	Gr.
137·5	−23·9	21·8	Lockyer II. 3	15 9h 8m	,,
? 140·5	,,	,,	,, II. 4	past 9h 20m	,,
144·4	−23·9	,,	Lassell 10	15·40	,,
153·7	−26·4	15·7	,, 21	Nov. 18·28	,,
162·1	−23·7	22·0	,, 9	Oct. 13·40	,,
162·3	−26·5	15·5	Kaiser I. 5	Nov. 19 8h 15m	Leiden.
163·0	−26·4	15·8	Lassell 20	17·28	Gr.
168·1	−26·4	16·1	Secchi 8	16 7h 16m	Rome.
179·7	−23·4	22·3	Lassell 8	Oct. 11·40	Gr.
188·6	−26·3	16·3	,, 19	Nov. 15·30	,,
195·8	−23·4	22·3	Kaiser I. 2	Oct. 11 11h 0m	Leiden.
199·9	−10·8	12·9	,, II. 12	65 Jan. 7 8h 0m	,,
201·2	−23·4	22·3	Lockyer III. 1	62 Oct. 11 11h 4m	Gr.
214·7	−23·1	22·5	,, III. 2	9 10h 47m	,,
220·1	− 6·2	17·3	Kaiser II. 5	64 Nov. 29 10h 10m	Leiden.
221·4	−26·2	17·1	Secchi 7	62 Nov. 11 7h 45m	Rome.
233·7	− 6·6	17·3	Dawes 4	64 Dec. 1 12h 0m	Gr.
236·4	−10·8	13·5	Kaiser II. 11	65 Jan. 3 8h 0m	Leiden.
238·1	−26·1	17·4	Secchi 6	62 Nov. 9 7h 38m	Rome.
240·2	−20·2	21·3	Harkness 1	Sept. 6 12h	Washgt.
248·7	− 4·2	17·4	Franzenau 4	64 Nov. 20 7h 30m	Vienna.
253·0	− 4·6	17·5	,, 6	22 9h 0m	,,
263·3	−22·4	22·9	Lockyer III. 3	62 Oct. 3 10h 30m	Gr.
264·1	−26·0	11·7	Kaiser I. 9	Dec. 14 6h 45m	Leiden.
271·8	−22·7	22·9	,, I. 1	Oct. 5 12h 35m	,,
274·3	− 5·6	17·4	Dawes 6	64 Nov. 26 11h 46m	Gr.
276·2	−22·4	22·9	Lockyer III. 4	62 Oct. 3 11h 23m	
278·0	−23·2	14·6	Rosse 1	July 22 22h 30m	Sid. T. Birr C.
280·4	− 4·2	17·4	Franzenau 5	64 Nov. 20 9h 40m	Vienna.
283·0	−22·4	22·9	Lockyer IV. 1	62 Oct. 3 11h 51m	Gr.
283·3	−22·8	22·7	Rosse 4	6 2h 10m	Sid. T. Birr C.
287·6	−25·9	18·1	Lassell 18	Nov. 5·32	Gr.
290·2	− 4·7	17·5	Kaiser II. 4	64 Nov. 22 10h 45m	Leiden.
290·8	−10·6	14·3	,, II. 10	Dec. 28 8h 0m	,,
295·9	−21·9	23·0	Lassell 7	62 Sept. 29·43	Gr.
296·7	−25·8	18·3	,, 17	Nov. 4·32	,,

Areographical Long. of the Centre of the Disk. °	Areographical Lat. of the Centre of the Disk. °	Diameter. ″			Times assigned to the Sketches.	
300·2	−26·1	12·1	Lassell 24		Dec. 11·29	Gr.
301·8	−21·6	23·0	Secchi 2		Sept. 26 9^h 45^m	Rome.
320·5	−21·7	23·0	Lassell 6		27·45	Gr.
322·1	− 3·2	17·3	Franzenau 3	64	Nov. 15 9^h 30^m	Vienna.
324·2	−26·2	12·3	Kaiser I. 8	62	Dec. 10 8^h 15^m	Leiden.
324·6	− 4·2	17·4	Dawes 8	64	Nov. 20 11^h 36^m	Gr.
325·2	− 4·0	17·4	Kaiser II. 3		19 11^h 20^m	Leiden.
328·8	−26·3	12·5	Lassell 23	62	Dec. 8·29	Gr.
328·9	−25·9	17·9	Rosse 6		Nov. 6 1^h 40^m	Sid. T. Birr C.
332·4	−21·1	22·8	Secchi 1		Sept. 21 20^h 50^m	Sid. T. Rome.
334·5	−21·5	22·9	Lassell 5		25·44	Gr.
337·2	,,	,,	Lockyer IV. 2		10^h 44^m	Finished.
338·6	,,	,,	,, IV. 3		10^h 50^m	,,
339·2	−21·3	22·9	,, IV. 4		23 9^h 40^m	,,
343·4	−21·4	22·9	Lassell 4		24·44	,,
344·4	−25·5	19·1	Kaiser I. 4		Oct. 31 8^h 45^m	Leiden.
350·2	−21·3	22·9	Lockyer I. 1		Sept. 23 10^h 25^m	Gr.
356·5	−10·2	15·0	Kaiser II. 9	1864	Dec. 23 9^h 25^m	Leiden.

On account of the uncertainty of the times assigned to the sketches, the longitudes of the central meridian may, of course, be considerably uncertain, an uncertainty of 1° of areographical longitude corresponding to about 4^m·1 in time.

By interpolating the longitudes given in the Ephemeris for the times, when observations are to be taken, and consulting the corresponding sketches, trustworthy observers may properly prepare themselves for fixing their attention upon the most desirable observations which can then be made. Amongst the most important are careful observations of the times and places of the passages across the central meridian of all the most distinct and well defined points on the planet's surface, which may serve as fundamental points of Areography. Foremost amongst them are the point *f* (the neck of the hour-glass), the spot *a* (the end of the serpentine), and the centre of spot *d* (the pupil of the eye) of Mädler's map of 1830. Since, in observing, the diameter of the disk —which passes through the southern polar spot S—will have to be taken as the central meridian, the observations will require to be corrected, not only for phase, for which the Ephemeris supplies the necessary data, but also for the non-coincidence of S with the southern pole, for the determination of which series of carefully observed angles of position of S are required. It is to be hoped that astronomers who have the requisite instruments at their service will not let slip the opportunities of the approaching opposition for making substantial contributions towards our better knowledge of *Mars*.

Note on the Results of Heliometer Observations of the Planet Juno, to determine its Diurnal Parallax.

By Lord Lindsay and Mr. David Gill.

The reduction of the observations made with the heliometer for determination of the diurnal parallax of *Juno* at Mauritius being finished, it may be of interest to present the final results to the Society in anticipation of the full details now in the press, forming vol. ii. of the Dun Echt publications.

Corrections of the tables of the planet were obtained, founded on the results of meridian observations at Greenwich and Washington, and a fine series of extrameridian observations made by Mr. Willson at Cambridge, U.S. In this latter series the stars of comparison were determined by Mr. Rogers with the transit circle of the same observatory.

Two systems of corrections were so obtained, founded on somewhat different expressions, greater weight being given to the Cambridge observations in the second system.

The computations were made separately on both systems, with the following result:—

	1st system.	2nd system.
Mean ⊙ parallax	$8''\cdot77 \pm 0''\cdot041$	$8''\cdot76 \pm 0''\cdot042$

From the late arrival of the yacht at Mauritius, the observations could not be commenced until a week after opposition.

In consequence of this barely one-third of the anticipated number of observations could be secured, and these, in consequence, with small parallax factors, rendered still smaller by the fact that stars of comparison could not be obtained in the most favourable positions.

This being, so we do not present the result as a determination of the parallax possessing a high weight. There is a discordant value on November 15, which in a larger series would have probably counter-balanced by another, in which all the sources of error had combined in the opposite way; and thus, if we are asked what we believe to be the most probable value resulting from the determination, we should reject this result. The values then become

1st system.	2nd system.
$8''\cdot82$	$8''\cdot81$

and these we believe to be exceedingly close approximations to the true ⊙ parallax.

At the same time we are aware that the rejection of any observation is quite unsound; and we simply present these values, not as a determination of the parallax, but as the result of a first experiment, made under somewhat trying and difficult circumstances, from which conclusions can be drawn as to the future value of the method.

That which we desire now more particularly to bring before the Society is the following table, showing the residuals in the

equations when the errors of the star places have been eliminated, and the first-mentioned values of π are substituted in them.

Each equation from which a residual results is the arithmetical mean of all the equations resulting from the comparisons in each epoch, so that the residuals show actually the errors of the observations in distance of each evening and morning.

A reference to the map of the path of *Juno*, published in connection with our paper in vol. xxxiv. p. 279 of the *Monthly Notices* of the Society, will show the stars of comparison referred to.

		Star of Comparison.	1st system.	2nd system.
			"	"
Nov. 12	Evening	θ	+0·088	+0·103
	Morning	θ	+0·129	+0·134
13	Evening	θ	−0·038	−0·034
	Morning	θ	−0·084	−0·094
15	Evening	ζ	−0·074	−0·075
	,,	λ	+0·114	+0·113
	Morning	ζ	+0·206	+0·199
	,,	λ	−0·213	−0·206
18	Morning	θ	−0·003	−0·001
	,,	μ	+0·012	+0·023
19	Evening	θ	+0·021	+0·024
	,,	μ	−0·016	−0·020
23	Evening	ι	+0·075	+0·053
	,,	χ	−0·080	−0·060
24	Morning	ι	−0·102	−0·069
	,,	χ	+0·101	+0·073
25	Evening	μ	−0·081	−0·134
	Morning	μ	−0·004	−0·042
26	Evening	μ	−0·153	−0·176
	Morning	μ	−0·051	−0·073
29	Morning	ν	−0·019	−0·180
30	Evening	ν	−0·194	−0·259

The resulting probable error of a complete comparison deduced from this table is $\pm$ 0″·075, confirming beyond all doubt the conclusion at which we arrived in the paper referred to, viz:

> *That by means of the Heliometer it is possible to determine the distance of a minor planet from a single star near it, or to interpolate its place relative to two distant stars, with a probable error less than $\frac{1}{10}$ th of a second of arc.*

A *near* star is one whose distance is less than 1000″ from the planet.

A *distant* star, from 1000″ to 7000″.

On the proposed Expedition to observe the approaching Opposition of Mars. By Mr. David Gill.

The approaching opposition of *Mars* is the most favourable of the century for determining the Solar Parallax, the horizontal parallax at opposition being within 5 per cent. of the difference of the horizontal parallax of the Sun and *Venus* at the Transit of 1874.

During six weeks observations can be made in conditions of temperature and of freedom from hurry or excitement infinitely more favourable to good observations than those afforded by the Transit of *Venus*. By observing the diurnal parallax, the same observer gets a result which is entirely free from errors of personality, and he also obtains a factor of parallax larger than can be obtained by any two existing observatories.

So early as 1857 the Astronomer Royal called attention to the present opposition, and then expressed his opinion—an opinion to which he still adheres—that observations of the diurnal parallax of the planet at such an opposition present the best means of determining the Solar Parallax.

The method proposed by the Astronomer Royal was to observe the difference of R.A. of the planet and stars in the evening and morning, and by such a method, with a proper equatoreal and a skilful observer, there is no doubt that results of very high accuracy could be attained. The success which has attended the observations of *Juno* (the results of which are communicated to the Society to-night) led me to believe that the original plan of the Astronomer Royal might be somewhat modified, and the heliometer successfully substituted for the ordinary equatoreal, according to a plan of observation afterwards described.

I applied in the first place to Lord Lindsay, who, in the kindest manner and with the most complete sympathy with the purposes in view, at once placed the instrument at my disposal.

I then submitted detailed plans of the proposed observations to the Astronomer Royal, to the Council of this Society, to Prof. Adams, and to Dr. Robinson and Mr. Hind, and I gratefully acknowledge the support in the matter which I have received at their hands, as also the promises of substantial assistance, should it be required, which I have received from Sir George Airy, Mr. De La Rue, Mr. Proctor, and others. I have also consulted Dr. Auwers of Berlin as to several details of these plans, and have now, as at all times, received from him the kindest and most valuable assistance. I now beg to present to the Society the following plan of the proposed observations:—

Selection of Place of Observation.

In heliometer observations distances are measured with much greater accuracy than position-angles, therefore we should endeavour to select stars nearly vertically above or below the

planet if we wish to have the full amount of parallactic displacement most advantageously measured. The star which is vertically above or below the planet in the evening observations (neglecting the planet's motion) can only be vertically above or below the planet in the morning in one case, and that is when the observer's station is on the equator and the star's and planet's declination are both 0°.

When the planet has any other declination, we must endeavour to select a station in which the planet is on the prime vertical at the mean altitude of observation (found practically to be 30°), and to select the stars of comparison of the same declination with the planet. The observations evening and morning are then symmetrically disposed as to parallactic displacement. In the case of *Mars* at the present opposition this condition is realised in a latitude about 8° S.

The meteorological conditions are also, of course, all-important, and it has been suggested to me that I should occupy some rainless district in the highlands of Peru, affording almost the certainty of clear weather every night. There appears to be a very serious drawback, however, in the great difference of temperature between day and night. It is no uncommon thing, in the higher districts there, to have a temperature verging on 100° Fahr. by day and freezing by night, and I feared, however perfectly and symmetrically the comparison stars and observations may be arranged for the elimination of progressive change of scale-value, that errors due to temperature may yet creep in which might have a systematic character.

In this respect insular stations have a great advantage, and after much consideration I have selected the Island of Ascension—originally suggested to me by Lieut. Neate, R.N.—as the most suitable site. Its geographical position is almost absolutely the best possible, and to Mr. Scott and Captain Toynbee I am indebted for a copy of a work, just issued by the Meteorological Office, on the meteorology of this island.

The proportion of cloud is from 5·0 to 6·0 (10 being total obscuration) for the date and hours of observation, a proportion smaller than Mauritius, where the conditions were sufficiently favourable. Two or three degrees appear to be the range of temperature between 6 P.M. and 6 A.M.

Selection of Stars of Comparison.

In making this selection, a complete list was independently prepared of all the stars of 8th magnitude or brighter near the path of *Mars* contained in the following catalogues:—

Catalogue of the Berlin Academy Star Maps.

Weisse's Bessel.

Lalande.

Santini.

Lacaille.

These were all independently reduced to 1877·0 and plotted on a chart, together with the path of the planet. It proved that several very important stars were omitted in Bessel's Catalogue; the reason, I believe, being, that when that Astronomer found two stars in the field and could not observe both, he always chose the fainter star, leaving the larger star to other observers, as less likely to be overlooked by them.

Such an omission is the star marked *g* ($7\frac{1}{2}$ mag.) in the catalogue, which is very important, because on September 5 the planet approaches within 2′ of this star.

In the selection of the stars of comparison, I have been guided by the following considerations:—

1. It is desirable, if possible, and if consistent with the main end in view—the parallax determination—to make the most accurate determination possible of the absolute place of the planet for the purposes of gravitational astronomy.
2. Position-angle measures being greatly inferior to measures of distance in point of accuracy, the determination of absolute positions will be best secured by relying on the distance measures only.
3. The minimum number of stars by which an absolute place can be secured by distance measures is three, and it is not desirable to measure more, because to measure from three stars symmetrically will require nearly all the time which the measures should occupy.
4. The planet *must* be contained within the triangle formed by the three stars of comparison; and, since the change in R.A. is the most important, two of the stars should be about the same declination with the planet, and as nearly as possible equally distant from it. When this is not possible, the stars must be arranged to determine rigidly the displacement in R.A., sacrificing, if necessary, the declination.
5. When stars can be found sufficiently bright, and nearly of the same declination with the planet, not more than 2000″ or 3000″ apart, then the method of two stars, employing position-angles, is best if the planet is nearly in the line joining the stars of comparison.

In the equations of condition which result from measures of distance with stars so selected, it is always possible to consider the error of the scale-value an unknown quantity, and to determine it from the stars of comparison in each group of observations. This is the best method for complete elimination of systematic error when the places of the stars of comparison are determined with tolerable precision.

To secure such precision, as well for this purpose as for the determination of the absolute place of the planet, the places of the stars of comparison must be determined by meridian observations; and to increase the precision of the result, the whole of

the stars should be connected by a heliometric triangulation. To effect this it has been necessary to introduce a few additional stars, in general denoted by Greek letters.

I have also included in the list the star ψ^1 *Aquarii*, because peculiar interest attaches to it from the fact that it was occulted by *Mars* in 1672, October 1. The occultation was observed by Richer at Cayenne, by Picard near Beauford, and by Roemer at Paris, and the observations are in very close accordance (Le Verrier, *Comptes Rendus*, 1872, July 22). In this paper, M. Le Verrier deduces the Earth's mass, and thence the solar parallax, from the secular variation of the planet's longitude produced in two centuries by the action of the Earth, employing the occultation just cited with Bradly's observations of the star, on the one hand, and modern meridian determinations on the other.

The present opportunity for making a rigid determination of the planet's heliocentric place is infinitely more favourable than that of 1672, because the determination can be made to depend upon so many stars. There is no doubt that, if many observations of the stars of comparison and of fundamental stars are made at different observatories and with different meridian circles, and the heliometer observations have even moderate success, a determination of the heliocentric place of the planet will be secured of far higher accuracy than any hitherto obtained.

I therefore most earnestly solicit the co-operation of observatories possessing good meridian instruments in this work, and shall gratefully acknowledge and utilise any such observations communicated to me, addressed to the Rooms of the Society.

Mr. Hartnup, at Liverpool, has most kindly volunteered to apply the splendidly rigid Equatoreal of his Observatory to the determination of the differences of R.A. and declination of these stars of comparison. These observations will chiefly strengthen the heliometric triangulation, but do not supersede the desirability, or even necessity, for good meridian observations also.

Stars to be observed with Mars at Opposition 1877.

Adopted Name of Star.	Approximate. 1877·0 R.A. h m s	Dec. ° ′	No. in Weisse's Bessel.	Mag.	Mag. in Berlin Academy Star Cat.	No. in Lalande.	Mag.	No. in Santini.	Mag.	Remarks.
a	22 47 0	−12 16	xxii. 956	7	6	44756	6	2577 (1858)	7	
b	22 47 38	−12 50	966	7–8	7–8	...	8	2140 (1862)	7–8	
a	22 51 37	−11 47	1047	9						
c	22 53 7	−13 44	1079	6	7	44937	6½	2145 (1862)	6–7	
β	22 56 4	−11 55	1156	8	8	45050	8	2591 (1858)	8–9	Lalande has Dec. −10° 55′.
μ	22 58 3	−12 50	1204	8	8	...	...	2154 (1862)	8	Schj. $22^h\ 58^m\ 2^s{\cdot}91$ $-12°\ 50'\ 26''{\cdot}8$ (8–7)
d	22 59 28	−11 6	1232	8	7–8	45169	7	2594 (1858)	8	
γ	23 0 30	−13 23	1249	8	8–9	45197	9			
e	23 0 58	−12 28	1261	8	8	45213	8	2599 (1858)	7–8	
δ	23 5 3	−11 10	xxiii. 49	9						
ϵ	23 5 32	−12 36	57	8	8	45380	7			
f	23 8 16	−11 21	123	7	7	45490	6			
g	23 8 55	−12 14	...	...	7–8	45504	7½			
ψ^1 Aq.	23 9 27	− 9 45	...	4–5						

h	23	11	15	−12	23	xxiii. 185	7	7	45582	6	2618 (1858)	7	
i	23	12	34	−10	17	226	5–6	5	45628	6	2622 (1858)	5–6	ψ^3 Aquarii.
k	23	12	37	−12	51	228	8	8	45633	7	2177 (1862)	7	
l	23	14	29	−11	12	265	8	8	45708	8	2625 (1858)	8	
λ	23	16	36	−11	27	309	8	8–9	45777	8	2627 (1858)	8	
ζ	23	16	55	−10	4	315	8	8	45789	8	...	...	Schj. $23^h\ 16^m\ 54^s{\cdot}26$ $-10°\ 3'\ 33''{\cdot}1$ (8–7)
η	23	20	14	−10	43	377	9						
m	23	21	40	−12	7	402	7	7	45937	6	2634 (1858)	7	
n	23	22	39	− 9	57	427	7	7	45965	6½	2636 (1858)	7	
q	23	26	4	−11	41	497	7	7	46090	6½	2643 (1858)	7	
r	23	29	6	−11	14	571	8	8	...	...	2653 (1858)	8	
s	23	29	40	− 9	27	586	7–8	7–8	46229	7½	...	...	Schj. $23^h\ 29^m\ 39^s{\cdot}37$ $-9°\ 26'\ 40''{\cdot}7$ (8)
	23	31	52	− 9	19	629	7	7	46296	7½			

Plan of Heliometric Triangulation of Stars to be compared with Mars.

Stars.	Mag.	R.A. h m s	Dec. ° ′	Position Angle. °	Distance. ′
a—*b*	6-7—7-8	22 47 19	−12 33	344·9	35
a—*a*	6-7—9	49 19	12 2	246·8	74
b—*a*	7-8—9	49 37	12 19	222·9	86
b—*c*	7-8—6-7	50 22	13 17	303·9	97
c—*a*	6-7—9	52 22	12 46	164·1	119
c—*β*	6-7—8	54 37	12 50	201·6	117
c—*γ*	6-7—8	56 47	13 34	259·0	110
a—*β*	9—8	53 51	11 51	277·0	66
β—*d*	8—7-8	57 46	11 31	225·6	70
β—*e*	8—8	58 31	12 12	294·7	79
β—*γ*	8—8	22 58 17	12 39	323·6	109
d—*δ*	7-8—9	23 2 16	11 8	272·8	82
d—*e*	7-8—8	0 13	11 47	344·9	85
γ—*e*	8—8	0 44	12 56	187·1	55
γ—*ϵ*	8—8	3 1	13 0	237·4	87
e—*δ*	8—9	3 1	11 49	217·6	98
e—*ϵ*	8—8	3 15	12 32	276·8	67
δ—ψ^1 Aq.	9—4-5	7 15	10 28	217·4	107
δ—*f*	9—6-7	6 40	11 16	283·1	49
δ—*g*	9—7-8	6 59	11 42	318·4	86
δ—*h*	9—6-7	8 9	11 47	308·7	117
δ—*ϵ*	9—8	5 18	11 53	355·3	86
ϵ—*f*	8—6-7	6 54	11 59	208·1	85
ϵ—*g*	8—7-8	7 14	12 25	246·1	54
ϵ—*h*	8—7	8 24	12 30	261·2	85
ϵ—*k*	8—7-8	9 5	12 44	278·2	105
f—ψ^1 Aq.	6-7—4-5	8 52	10 33	190·3	98
f—*g*	6-7—7-8	8 36	11 48	349·7	54
f—*h*	6-7—7	9 46	11 52	324·7	76
f—*i*	6-7—5-6	10 25	10 49	224·8	90
f—*l*	6-7—8	11 23	11 17	264·4	92
f—*k*	6-7—7-8	10 27	12 6	324.7	110
g—*e*	7-8—8	4 57	12 21	83·2	117
g—*h*	7-8—7	10 5	12 19	284·8	35
g—*k*	7-8—7-8	10 46	12 33	304·4	66
g—*l*	7-8—8	11 42	11 43	232·9	103
ψ^1 Aq.—*ζ*	4-5—8	13 11	9 55	279·8	112

Stars.	Mag.	R.A. h m s	Dec. ° ′	Position Angle. °	Distance. ″
ψ^1 Aq.—i	4-5—5-6	23 11 1	−10 1	304·7	56
ψ^1 Aq.—l	4-5—8	11 58	10 29	319·5	114
h—l	6-7—8	12 52	11 48	213·8	85
h—k	6-7—7-8	11 56	12 37	324·5	34
i—ζ	5-6—8	14 45	10 11	258·6	66
i—l	5-6—8	13 32	10 45	332·8	62
k—l	7-8—8	13 33	12 2	195·5	103
l—ζ	8—8	15 42	10 38	207·8	77
l—η	8—9	17 22	10 58	251·1	90
l—m	8—6-7	18 5	11 40	297·5	119
ζ—n	8—6-7	19 47	10 1	265·3	85
ζ—η	8—9	18 35	10 24	308·5	63
η—q	9—7	23 9	11 12	304·4	104
η—m	9—6-7	20 57	11 25	345·9	87
η—n	9—6-7	21 27	10 20	217·8	58
m—q	6-7—7	23 52	11 54	248·1	70
n—q	6-7—7	24 22	10 49	334·2	116
n—r	6-7—8	25 56	10 36	309·0	122
n—s	6-7—7-8	26 10	9 42	253·9	108
q—r	7—8	27 35	11 28	238·8	52
r—s	8—7-8	29 23	10 21	184·5	107
s—t	7-8—7	30 46	9 23	256·2	33
λ—h	8—6-7	13 56	11 55	54·4	96
λ—i	8—5-6	14 35	10 52	139·6	92
λ—k	8—7-8	14 37	12 9	34·9	102
λ—l	8—8	15 33	11 20	115·5	35
λ—m	8—6-7	19 8	11 47	298·2	85
λ—η	8—9	18 25	11 5	230·5	69
λ—ζ	8—9	23 16 46	10 46	183·3	83
μ—a	8—9	22 54 49	12 19	123·9	113
μ—β	8—8	57 3	12 23	152·5	62
μ—c	8—6-7	55 34	13 17	52·8	89
μ—γ	8—8	59 16	13 7	312·2	49
μ—d	8—7-8	58 45	11 58	191·6	106
μ—e	8—8	22 59 30	12 39	243·0	48
μ—ϵ	8—8	23 1 47	12 43	262·8	111

Plan of Observation of Mars and Comparison Stars.

[P denotes the planet; other letters the stars in the preceding list.]

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point.	Dec. of Middle Point.	Position Angle.	Distance.	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point.	Dec. of Middle Point.	Position Angle.	Distance.
			h m s	° ′	°	′	h m s	° ′	°	′
Aug. 1	P—*q*	7-8	23 26 58	−10 44	13·0	117	23 27 1	−10 44	13·8	116
	P—*n*	7	25 15	9 52	82·6	77	25 18	9 52	83·5	79
	P—*t*	7	29 52	9 33	244·8	66	29 55	9 33	243·4	65
2	P—*q*	7-8	27 5	10 45	15·0	116	27 8	10 45	15·7	116
	P—*n*	7	25 22	9 53	84·3	81	25 25	9 53	84·4	82
	P—*t*	7	29 59	9 34	241·7	63	30 2	9 34	241·0	62
3	P—*q*	7-8	27 12	10 46	16·7	116	27 13	10 46	17·0	115
	P—*n*	7	25 29	9 54	85·2	84	25 30	9 54	85·9	84
	P—*t*	7	30 6	9 35	239·5	61	30 7	9 35	238·4	61
4	P—*q*	7-8	27 16	10 47	17·9	114	27 17	10 47	18·3	114
	P—*n*	7	25 33	9 55	86·7	87	25 34	9 55	87·4	88
	P—*t*	7	30 10	9 36	236·9	60	30 11	9 36	235·7	60
5	P—*q*	7-8	27 19	10 48	18·9	113	27 19	10 48	19·2	112
	P—*n*	7	25 36	9 56	88·0	88	25 36	9 56	88·7	88
	P—*t*	7	30 11	9 37	234·5	60	30 11	9 37	233·6	61
6	P—*q*	7-8	27 20	10 49	19·6	111	27 20	10 49	19·7	110
	P—*n*	7	25 37	9 57	90·0	89	25 37	9 57	90·0	89
	P—*t*	7	30 12	9 38	232·4	61	30 12	9 38	231·8	61

7	P—*q*	7-8	27	20	10	50	20·0	109	27	20	10	51	20·2	108
	P—*n*	7	25	37	9	58	91·0	89	25	37	9	59	91·0	89
	P—*t*	7	30	12	9	38	230·5	63	30	12	9	39	229·9	64
8	P—*q*	7-8	27	17	10	52	19·9	105	27	17	10	52	20·0	104
	P—*n*	7	25	34	10	0	93·3	87	25	34	10	0	94·0	86
	P—*t*	7	30	9	9	41	229·2	66	30	9	9	41	228·7	67
9	P—*q*	7-8	27	14	10	53	19·7	102	27	13	10	54	19·6	101
	P—*n*	7	25	31	10	1	95·4	85	25	30	10	2	96·1	85
	P—*t*	7	30	6	9	42	228·1	69	30	5	9	43	227·8	70
10	P—*q*	7-8	27	9	10	55	18·8	98	27	7	10	55	18·7	96
	P—*n*	7	25	26	10	3	97·6	83	25	24	10	3	98·4	82
	P—*t*	7	30	1	9	44	227·8	73	29	59	9	44	227·7	74
11	P—*q*	7-8	27	2	10	57	17·8	93	27	0	10	57	17·2	92
	P—*n*	7	25	19	10	5	100·7	81	25	17	10	5	101·6	79
	P—*t*	7	29	54	9	46	227·2	78	29	52	9	46	227·3	80
12	P—*q*	7-8	26	54	10	58	16·1	88	26	51	10	59	15·3	87
	P—*n*	7	25	11	10	6	104·2	77	25	8	10	7	105·2	76
	P—*t*	7	29	46	9	47	227·1	84	29	43	9	48	227·3	86
13	P—*q*	7-8	26	44	11	0	13·6	83	26	40	11	1	12·5	82
	P—*n*	7	25	1	10	8	107·4	74	24	57	10	9	109·4	72
	P—*t*	7	29	35	9	49	227·3	90	29	31	9	50	227·6	92
14	P—*q*	7-8	26	33	11	2	10·3	78	26	29	11	3	9·1	76
	P—*n*	7	24	50	10	10	112·7	70	24	46	10	11	114·1	69
	P—*t*	7	29	24	9	51	227·8	97	29	20	9	52	228·2	99

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ″	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ″
Aug. 15	P—*q*	7-8	23 26 21	−11 4	6·3	73	23 26 16	−11 5	4·8	72
	P—*n*	7	24 38	10 12	117·9	66	25 33	10 13	119·7	65
	P—*s*	7-8	28 9	9 57	216·5	76	28 40	9 58	217·5	78
16	P—*q*	7-8	26 5	11 7	0·0	69	26 2	11 7	358·9	67
	P—*n*	7	24 22	10 15	124·5	62	24 19	10 15	127·0	62
	P—*s*	7-8	27 53	10 0	219·0	84	27 50	10 0	219·1	86
17	P—*q*	7-8	25 50	11 9	353·6	64	25 46	11 10	351·7	64
	P—*n*	7	24 7	10 17	132·7	59	24 3	10 18	134·8	58
	P—*s*	7-8	27 38	10 2	220·8	92	27 34	10 3	221·3	94
18	P—*q*	7-8	25 33	11 11	345·3	60	25 27	11 12	342·7	61
	P—*n*	7	23 50	10 19	142·2	57	23 45	10 20	144·9	56
	P—*s*	7-8	27 21	10 4	222·5	102	27 16	10 5	223·2	104
19	P—*m*	7	23 2	11 27	26·4	90	22 55	11 27	24·9	87
	P—*n*	7	23 32	10 22	152·1	55	23 25	10 22	156·1	56
	P—*r*	8	26 45	11 0	292·0	75	26 38	11 0	289·7	77
20	P—*m*	7	22 42	11 29	22·0	82	22 36	11 30	20·3	79
	P—*n*	7	23 12	10 24	163·3	56	23 6	10 25	166·8	58
	P—*r*	8	26 26	11 3	286·3	82	26 20	11 3	284·4	85
21	P—*m*	7	22 21	11 32	16·0	74	22 14	11 32	13·9	71
	P—*n*	7	22 51	10 27	174·3	59	22 44	10 27	177·7	61
	P—*r*	8	26 5	11 5	281·4	91	25 58	11 5	279·8	94

22	P—*m*	7	22	0	11	34	8·7	67	21	52	11	35	5·3	64
	P—*n*	7	22	30	10	29	183·9	64	22	22	10	30	187·5	67
	P—*q*	7–8	24	13	11	21	306·2	68	24	4	11	22	302·9	70
23	P—*m*	7	21	36	11	37	358·3	60	21	28	11	38	354·5	59
	P—*n*	7	22	6	10	32	193·2	71	21	58	10	33	195·9	74
	P *q*	7–8	23	49	11	24	297·1	75	23	41	11	25	294·5	77
24	P—*n*	7	21	41	10	34	200·7	80	21	33	10	35	203·0	83
	P—*q*	7–8	23	24	11	26	291·9	84	23	16	11	27	288·8	87
	P—*l*	8	17	37	11	12	90·0	92	17	29	11	13	90·7	88
25	P—*n*	7	21	15	10	37	207·2	90	21	7	10	38	208·8	94
	P—*q*	7–8	22	58	11	29	284·8	94	22	50	11	30	283·1	98
	P—*l*	8	17	11	11	15	93·6	79	17	3	11	16	95·3	75
26	P—*n*	7	20	51	10	40	212·4	101	20	40	10	40	213·8	105
	P—*q*	7–8	22	34	11	32	280·4	106	22	23	11	32	278·9	110
	P—*l*	8	16	47	11	18	98·6	67	16	36	11	18	100·9	63
27	P—*n*	7	20	22	10	42	216·9	113	20	13	10	43	218·1	117
	P—*m*	7	19	52	11	47	307·1	66	19	43	11	48	303·6	69
	P—*l*	8	16	17	11	20	105·9	55	16	8	11	21	109·4	51
28	P—*i*	5–6	14	51	10	55	138·2	101	14	41	10	56	141·0	99
	P—*h*	7	14	11	11	58	59·9	100	14	1	11	59	59·0	95
	P—*m*	7	19	24	11	50	296·9	75	19	14	11	51	294·8	79
29	P—*i*	5–6	14	21	10	57	146·7	96	14	12	10	58	149·6	95
	P—*h*	7	13	40	12	0	57·9	85	13	31	12	1	56·8	80
	P—*m*	7	18	54	11	52	289·6	86	18	45	11	53	288·1	90

Day. 1877.	Star Comparison	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′
Aug. 30	P—*i*	5-6	23 13 52	−11 0	156·1	94	23 13 42	−11 1	159·0	93
	P—*h*	7	13 12	12 3	55·0	70	13 2	12 4	53·5	66
	P—*m*	7	18 25	11 55	284·1	99	18 15	11 56	282·9	103
31	P—λ	8	15 23	11 37	239·8	42	15 13	11 38	241·8	47
	P—*f*	6-7	11 13	11 34	107·3	91	11 3	11 35	108·9	86
	P—*h*	7	12 42	12 5	50·5	55	12 32	6	47·9	51
Sept. 1	P—λ	8	14 52	11 40	243·1	58	14 42	11 41	244·4	63
	P—*f*	6-7	10 42	11 37	114·2	78	10 32	11 38	116·5	74
	P—*h*	7	12 11	12 8	42·4	41	12 1	12 9	37·6	37
2	P—λ	8	14 19	11 42	245·2	74	14 9	11 43	246·1	79
	P—*f*	6-7	10 10	11 39	123·8	67	10 0	11 40	127·0	63
	P—*g*	7-8	10 29	12 6	70·7	48	10 19	12 7	69·8	43
3	P—*h*	6-7	11 8	12 13	278·0	21	10 58	11 9	294·9	21
	P—*g*	7-8	9 58	12 8	68·6	33	9 48	12 9	68·7	28
	P—λ	8	13 48	11 45	247·0	89	13 38	11 46	247·1	95
4	P—*f*	6-7	9 6	11 44	152·2	52	8 56	11 45	157·9	51
	P—*h*	6-7	10 35	12 15	309·4	25	10 25	12 16	301·3	29
	P—*g*	7-8	9 26	12 11	64·5	15	9 16	12 12	58·0	10
5	P—*g*	7-8	8 54	12 13	336·6	3	8 43	12 14	282·8	7
6	*f*—*g*	{6-7 / 7-8}	8 36	11 48	349·7	54	8 36	11 48	349·7	54

	P—*g*	7-8		8	21	12	15	265·3	17		8	10	12	15	263·4	26
	P—*f*	6-7		8	1	11	48	188·0	55		7	50	11	49	193·1	57
7	P—*f*	6-7		7	29	11	50	202·1	63		7	18	11	51	206·1	66
	P—*h*	6-7		8	58	12	21	273·1	67		8	47	12	22	272·0	73
	P—*e*	8		3	49	12	24	84·1	84		3	38	12	24	84·5	79
8	P—*f*	6-7		6	56	11	52	212·5	74		6	45	11	53	215·4	77
	P—*h*	6-7		8	25	12	23	270·0	83		8	14	12	24	269·2	88
	P—*e*	8		3	16	12	26	88·7	68		3	5	12	27	88·7	62
9	P—*f*	6-7		6	23	11	54	220·0	86		6	12	11	54	222·1	90
	P—*g*	7-8		6	43	12	21	258·8	67		6	32	12	21	258·7	71
	P—*e*	8		2	43	12	28	88·6	52		2	32	12	28	88·8	47
10	P—*d*	8		1	27	11	48	145·2	102		1	16	11	48	148·0	100
	P—*g*	7-8		6	11	12	22	258·8	82		6	0	12	22	258·8	87
	P—*e*	8		2	12	12	29	93·2	36		2	1	12	29	95·5	31
11	P—*g*	7-8		5	39	12	24	258·8	97		5	28	12	24	258·8	106
	P—*e*	8		1	41	12	31	103·5	21		1	30	12	31	111·0	16
	P—*d*	7-8		0	56	11	50	153·8	97		0	45	11	50	156·8	96
12	P—*g*	7-8		5	8	12	25	258·8	113		4	57	12	25	258·8	118
	P—*e*	8		1	10	12	32	144·5	10		0	59	12	32	176·8	9
	P—*d*	7-8	23	0	25	11	51	162·9	94	23	0	14	11	51	166·1	94
13	P—μ	8	22	59	11	12	44	70·5	36	22	59	1	12	45	69·3	31
	P—*e*	8	23	0	39	12	33	222·9	13	23	0	29	12	34	232·2	18
	P—*d*	7-8	22	59	54	11	52	172·1	93	22	59	44	11	53	175·2	93

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′	Hour Angle $+4^h$ (Morning Observations.) R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′
Sept. 14	P—μ	8	22 58 41	−12 45	63·8	21	22 58 31	−12 46	58·0	17
	P—e	8	23 0 9	12 34	242·4	27	59 59	12 35	245·7	31
	P—d	7–8	22 59 24	11 53	181·2	94	59 14	11 54	184·2	95
15	P—d	7–8	58 55	11 54	189·6	97	58 45	11 54	192·2	99
	P—c	6–7	55 45	13 13	51·1	99	55 35	13 13	49·7	94
	P—e	8	59 40	12 35	249·8	41	59 30	12 35	250·7	45
16	P—d	7–8	58 25	11 55	197·2	103	58 15	11 55	199·5	104
	P—c	6–7	55 16	13 14	46·2	87	55 6	13 14	44·1	84
	P—e	8	59 11	12 36	253·0	55	59 2	12 36	254·2	59
17	P—d	7–8	57 59	11 56	203·9	108	57 50	11 56	205·7	111
	P—c	6–7	54 49	13 15	39·8	77	54 40	13 15	37·2	74
	P—e	8	58 44	12 37	255·3	68	58 35	12 37	256·0	72
18	P—d	7–8	57 32	11 56	209·6	115	57 23	11 56	211·4	117
	P—c	6–7	54 22	13 15	32·2	68	54 13	13 15	28·8	66
	P—μ	8	56 49	12 48	276·1	36	56 40	12 48	275·2	40
19	P—c	6–7	53 57	13 15	23·0	62	53 49	13 16	19·5	60
	P—b	7–8	51 12	12 48	88·4	104	51 4	12 49	88·3	101
	P—e	8	57 52	12 37	258·2	93	57 44	12 38	258·7	97
20	P—c	6–7	53 32	13 16	11·9	58	53 25	13 16	8·3	58
	P—b	7–8	50 47	12 49	88·1	92	50 40	12 49	88·1	89
	P—e	8	57 27	12 38	259·5	105	57 20	12 38	259·9	108

21	P—*c*	6–7	53	9	13	16	0·0	57	53	2	13	16	357·1	57
	P—*b*	7–8	50	24	12	49	87·9	81	50	17	12	49	87·8	77
	P—μ	8	55	36	12	49	272·3	71	55	29	12	49	272·2	75
22	P—*c*	6–7	52	47	13	15	350·1	58	52	39	13	15	346·6	59
	P—*b*	7–8	50	2	12	48	87·6	70	49	54	12	48	87·4	67
	P—μ	8	55	14	12	49	272·3	82	55	6	12	49	272·3	85
23	P—*c*	6–7	52	26	13	15	340·8	61	52	19	13	15	337·9	63
	P—*b*	7–8	49	41	12	48	86·2	60	49	34	12	48	86·0	57
	P—μ	8	54	55	12	49	272·4	92	54	46	12	49	272·5	96
24	P—*c*	6–7	52	6	13	15	332·9	66	52	0	13	14	330·9	68
	P—*b*	7–8	49	21	12	48	84·4	51	49	15	12	47	84·0	48
	P—μ	8	54	33	12	48	272·7	102	54	27	12	47	272·8	105
25	P—*c*	6–7	51	48	13	14	327·2	71	51	42	13	14	325·5	73
	P—*b*	7–8	49	3	12	47	81·6	42	48	57	12	47	80·4	39
	P—μ	8	54	15	12	47	273·2	111	54	9	12	47	273·3	114
26	P—*c*	6–7	51	30	13	13	322·6	78	51	25	13	13	321·3	79
	P—*b*	7–8	48	45	12	46	76·3	33	48	40	12	46	75·3	31
	P—*a*	6–7	48	26	12	29	121·8	49	48	21	12	29	123·2	48
27	P—*c*	6–7	51	14	13	12	319·3	84	51	10	13	12	318·2	86
	P—*b*	7–8	48	29	12	45	68·4	27	48	25	12	45	66·4	25
	P—*a*	6–7	48	11	12	28	124·9	42	48	7	12	28	126·7	40
28	P—*c*	6–7	51	0	13	11	316·7	91	50	56	13	11	316·3	92
	P—*b*	7–8	48	15	12	44	56·3	22	48	11	12	44	51·1	21
	P—*a*	6–7	47	56	12	27	128·9	35	47	52	12	27	130·9	34

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′
Sept. 29	*a*—*b*	7-7	22 47 19	−12 33	344·9	35	22 47 19	−12 33	344·9	35
	P—*b*	7-8	48 3	12 43	40·5	18	47 59	12 42	33·6	18
	P—*a*	6-7	47 44	12 26	132·6	29	47 40	12 25	134·3	27
30	*a*—*b*	7 & 7-8	47 19	12 33	344·9	35	47 19	12 33	344·9	35
	P—*b*	7-8	47 51	12 41	20·3	18	47 48	12 41	14·6	19
	P—*a*	6-7	47 32	12 24	137·5	23	47 29	12 24	138·8	21
Oct. 1	P—*a*	6-7	47 22	12 23	141·7	17	47 19	12 22	143·1	16
	P—*b*	7-8	47 41	12 40	3·6	21	47 38	12 39	0·0	22
2	P—*a*	6-7	47 13	12 21	147·4	12	47 11	12 20	149·0	10
	P—*b*	7-8	47 32	12 38	353·1	24	47 30	12 37	351·1	25
3	P—*a*	6-7	47 6	12 19	154·2	7	47 4	12 18	158·2	5
	P—*b*	7-8	47 25	12 36	347·3	29	47 23	12 35	345·9	30
4	P—*a*	6-7	47 2	12 17	166·6	3	47 0	12 16	180·0	1
	P—*b*	7-8	22 47 21	−12 34	345·0	33	22 47 19	−12 33	344·3	34

On the Opposition of the Minor Planet Ariadne as a means of determining the Solar Parallax. By Mr. David Gill.

The minor planet *Ariadne* (43) is in opposition on July 24 of the present year, in circumstances very favourable for determining its diurnal parallax by the heliometric method. The distance of the planet from the Earth is 0·83, the Sun's mean distance from the Earth being 1.

Its declination (−15°) is not far from the most favourable position for observation at Ascension, and opposition occurs ten days before it is possible to begin to observe *Mars* satisfactorily. The observations can therefore be made without inconvenience or additional expense.

It is true the planet is somewhat faint (8·8 mag.), but experience at Mauritius has taught me that with such a heliometer as Lord Lindsay's, in a tropical sky, 8·5 mag. stars can be measured with more accuracy than any other, and that 9th mag. stars can be well measured in favourable atmospheric conditions.

The geometrical conditions are very much more favourable than in the case of *Juno* (the distance of *Juno* at opposition was 1·05); and, besides, it is possible to select more suitable stars of comparison. The opportunity therefore appears a very good one, and I have accordingly selected stars of comparison, of which the subjoined is a list.

In addition to this list, absolutely required for comparison with the planet, are a few stars required in the triangulation of the comparison stars, the latter are denoted by Greek letters.

The plan of observation is given in connection with the following tables, as also the plan of triangulation of the stars of comparison.

I shall be greatly indebted to any astronomer who will assist this determination in any of the following ways :—

1. By meridian observations of the stars of comparison.

2. By extra-meridian determinations of the difference of R.A. and declination of any of the stars of comparison, but especially by accurate measures of the difference of declination of the stars *f*, *c*. These stars will be used by me to determine the zero of the position-circle in the triangulation, and, as they do not differ 2′ in declination, the observation can be made by means of the wire micrometer with very great accuracy.

3. By heliometer measures, either of the star and planet, or of the distances and position-angles of the stars included in the plan of triangulation.

4. By a series either of meridian or extra-meridian observations of the planet, extending as far as possible on both sides of opposition.

The oppositions of *Iris* (7) and *Melpomene* (18) are also very favourable. I will notice them more at length at the next meeting of the Society.

Stars to be observed with Ariadne at Opposition 1877.

Adopted Name of Star.	Approximate R.A. h m s	Dec. ° ′	No. in Oeltzen's Argelander.		No. in Lalande.		No. in Weisse's Bessel.		No. in Santini.		Remarks.
a	20 8 28	−15 8	20345	8–9							
b	20 12 9	−14 39	20392	7–8							
c	20 12 57	−15 23	20407	8							
d	20 16 34	−14 39	...	...	39140	7½	...		...		Also in Berlin Acad. Star Cat.
e	20 18 24	−15 13	20489	8–9	39210	8½					
f	20 19 10	−15 22	20496	7–8	39247	8					
α	20 19 27	−14 16	...	...	...	...	xx. 445	8	1850	7–8	
β	20 22 8	−15 27	20541	9							
γ	20 25 2	−14 11	...	...	39486	8	588	9	1859	9	
g	20 27 21	−14 9	...	...	39579	7	646	7	1865	7	
k	20 27 52	−14 52	...	...	...	...	664	9			
h	20 29 23	−15 44	20642	8	39671	9					

Plan of Heliometric Triangulation of Stars to be compared with Ariadne.

Stars.	Mag.	R.A. h m s	Dec. ° ′	Position Angle. °	Dist. ′
a—b	8-9—7-8	20 10 19	−14 54	241·6	61
a—c	8-9—8	10 43	15 16	283·0	67
b—c	7-8—8	12 33	15 1	345·2	46
b—d	7-8—7-8	14 22	14 39	270	64
b—e	7-8—8-9	15 17	14 56	290·6	97
b—α	7-8—7-8	15 48	14 28	257·8	108
c—d	8—7-8	14 46	15 1	230·0	68
c—e	8—8-9	15 41	15 18	262·8	80
c—α	8—7-0	16 12	14 50	234·6	116
d—e	7-8—8-9	17 29	14 56	322·0	43
d—f	7-8—7-8	17 52	15 1	318·8	57
d—α	7-8—7-8	18 1	14 28	241·2	48
d—β	7-8—9	19 21	15 3	300·7	94
e—f	8-9—7-8	18 47	15 18	309·0	14
e—α	8-9—7-8	18 56	14 45	195·0	59
e—β	8-9—9	20 16	15 20	284·5	56
e—γ	8-9—8-9	21 43	14 42	237·2	114
f—α	7-8—7-8	19 19	14 49	183·7	66
f—β	7-8—9	20 39	15 25	276·6	43
f—γ	7-8—8-9	22 6	14 47	230·2	111
g—h	7—8-9	28 22	14 57	342·8	99
g—α	7—7-8	23 24	14 13	86·5	115
g—β	7—9	24 45	14 48	44·2	109
g—γ	7—8-9	26 12	14 10	86·6	34
h—β	8-9—9	25 46	15 36	99·2	106
h—γ	8-9—8-9	27 13	14 58	145·9	112
α—β	7-8—9	20 48	14 52	331·2	81
α—γ	7-8—8-9	22 15	14 14	226·5	81
β—γ	9—8-9	23 35	14 48	209·0	87
k—g	9—7	27 37	14 31	170·0	44
k—h	9—8-9	28 38	15 18	337·0	57
k—β	9—9	25 0	15 10	67·8	90
k—γ	9—8-9	20 26 27	−14 32	134·9	58

Plan of Observations of Ariadne and Comparison Stars.

[P denotes the planet; other letters the stars in the preceding list.]

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′
July 13	P—*f*	7–8	20 22 40	−15 10	76·7	104	20 22 31	−15 10	76·1	100
	P—*g*	7	26 46	14 34	199·3	52	26 37	14 34	203·8	54
	P—*h*	8–9	27 47	15 21	314·6	65	27 38	15 21	312·0	69
	P—*k*	9	27 1	14 55	255·5	26	26 52	14 55	257·7	30
14	P—*f*	7–8	22 13	15 10	74·8	92	22 4	15 10	74·1	87
	P—*g*	7	26 19	14 34	211·7	58	26 10	14 34	215·2	60
	P—*h*	8–9	27 20	15 21	307·6	75	27 11	15 21	305·7	79
	P—*k*	9	26 34	14 55	260·7	38	26 25	14 55	261·8	43
15	P—*f*	7–8	21 46	15 10	72·3	79	21 37	15 10	71·3	75
	P—*g*	7	25 52	14 34	221·5	65	25 43	14 34	224·2	68
	P—*h*	8–9	26 53	15 21	302·3	86	26 44	15 21	300·8	90
	P—*k*	9	26 7	14 55	263·3	51	25 58	14 55	263·8	55
16	P—*e*	8–9	20 56	15 6	78·6	75	20 47	15 6	78·0	70
	P—*g*	7	25 24	14 34	229·0	75	25 15	14 34	231·3	78
	P—*h*	8–9	26 25	15 21	298·2	97	26 15	15 21	297·0	101
	P—*k*	9	25 40	14 55	264·7	64	25 30	14 55	265·0	69
17	P—*d*	7–8	19 33	14 49	102·4	88	19 23	14 49	103·1	84
	P—*f*	7–8	20 51	15 10	63·8	54	20 41	15 10	61·4	50

	P—*g*	7	24	56	14	34	235·1	86	24	47	14	34	236·7	89
	P—*k*	9	25	12	14	55	265·5	78	25	2	14	55	265·8	82
18	P—*d*	7–8	19	4	14	49	104·7	75	18	55	14	49	105·6	71
	P—*f*	7–8	20	22	15	10	55·4	42	20	13	15	10	51·8	39
	P—*g*	7	24	28	14	34	239·7	97	24	19	14	34	241·0	101
	P—*k*	9	24	43	14	55	266·1	92	24	34	14	55	266·2	96
19	P—*d*	7–8	18	36	14	49	108·4	62	18	27	14	49	109·8	58
	P—*e*	8–9	19	31	15	6	65·8	35	19	22	15	6	62·6	31
	P—*k*	9	24	15	14	55	266·5	105	24	6	14	55	266·6	110
	P—*c*	8	16	47	15	11	77·6	114	16	38	15	11	77·1	110
	P—*β*	9	21	23	15	13	322·2	36	21	14	15	13	317·1	39
20	P—*c*	8	16	18	15	11	76·0	100	16	9	15	11	75·5	96
	P—*d*	7–8	18	7	14	49	113·9	49	17	58	14	49	116·3	45
	P—*e*	8–9	19	2	15	6	52·0	23	18	53	15	6	44·6	20
	P—*α*	7–8	19	33	14	37	176·1	43	19	24	14	37	178·1	43
	P—*β*	9	20	54	15	13	308·1	46	20	45	15	13	304·7	49
21	P—*b*	7–8	15	25	14	49	102·0	97	15	16	14	49	102·7	93
	P—*c*	8	15	49	15	11	74·0	86	15	40	15	11	73·3	82
	P—*d*	7–8	17	38	14	49	123·3	37	17	29	14	49	127·7	33
	P—*e*	8–9	18	33	15	6	16·6	14	18	24	15	6	359·0	14
	P—*α*	7–8	19	4	14	38	194·4	45	18	55	14	38	199·7	46
	P—*β*	9	20	25	15	13	299·0	57	20	16	15	13	296·9	61
22	P—*b*	7–8	14	56	14	49	104·4	83	14	47	14	49	105·3	79
	P—*c*	8	15	20	15	11	71·6	73	15	10	15	11	70·4	69

Day. 1877.	Stars of Comparison.	Mag.	Hour Angle -4^h (Evening Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′	Hour Angle $+4^h$ (Morning Observations). R.A. of Middle Point. h m s	Dec. of Middle Point. ° ′	Position Angle. °	Distance. ′
July 22	P—*e*	8–9	20 18 4	−15 6	323·1	17	20 17 54	−15 6	312·1	20
	P—*a*	7–8	18 35	14 38	210·0	50	18 26	14 38	214·2	53
	P—*β*	9	19 56	15 13	293·1	70	19 46	15 13	291·6	74
23	P—*c*	8	14 51	15 12	67·4	60	14 41	15 12	66·0	55
	P—*d*	7–8	16 40	14 50	172·9	21	16 30	14 50	185·1	22
	P—*e*	8–9	17 35	15 7	297·9	27	17 25	15 7	293·0	31
	P—*a*	7–8	14 27	14 50	221·4	59	14 18	14 50	224·6	62
24	P—*c*	8	14 22	15 12	61·7	47	14 12	15 12	59·1	43
	P—*b*	7–8	13 58	14 50	112·7	57	13 48	14 50	114·5	53
	P—*e*	8–9	17 6	15 7	287·7	40	16 56	15 7	285·7	44
	P—*d*	7–8	16 11	14 50	207·7	25	16 1	14 50	214·4	27
25	P—*a*	8–9	11 39	15 4	86·0	93	11 30	15 4	86 0	88
	P—*b*	7–8	13 30	14 50	120·5	45	13 21	14 50	123·8	41
	P—*e*	8–9	16 37	15 7	282·4	53	16 28	15 7	281·3	57
	P—*d*	7–8	15 42	14 50	228·0	34	15 33	14 50	232·6	38
26	P—*a*	8–9	11 10	15 5	85·8	79	11 1	15 5	85·8	74
	P—*b*	7–8	13 1	14 51	132·6	34	12 52	14 51	139·8	31
	P—*e*	8–9	16 8	15 8	279·3	67	15 59	15 8	278·4	71
27	P—*a*	8–9	10 41	15 6	85·7	64	10 32	15 6	85·6	60
	P—*b*	7–8	12 32	14 51	155·6	26	12 23	14 51	165·3	25
	P—*e*	8–9	15 39	15 8	277·1	80	15 30	15 8	276·5	85

28	P—*a*	8–9		10	13	15	6	85·4	51		10	4	15	7	85·3	46
	P—*b*	7–8		12	3	14	51	186·6	25		11	54	14	52	196·1	26
	P—*d*	7–8		14	16	14	51	249 6	71		14	7	14	52	250·6	76
	P—*e*	8–9		15	11	15	8	275·6	94		15	2	15	9	275·2	98
29	P—*a*	8–9		9	45	15	6	85·1			9	36	15	7	84·9	33
	P—*b*	7–8		11	35	14	52	212·6	31		11	26	14	53	218·7	33
	P—*c*	8		11	59	15	14	302·7	34		11	50	15	15	299·1	37
30	P—*a*	8–9		9	17	15	7	84·7	24		9	8	15	7	84·3	19
	P—*b*	7–8		11	8	14	52	227·8	40		10	59	14	52	231·8	44
	P—*c*	8		11	31	15	14	292·3	45		11	22	15	14	290·3	49
31	P—*a*	8–9		8	50	15	7	83·4	10		8	40	15	7	81·2	7
Aug. 1	P—*a*	8–9	20	8	22	−15	8	270·0	3	20	8	13	−15	8	270·0	7

Notes.

July 13. If *k* is bright enough it will be best to use the stars *f* and *k* to determine the parallax, measuring to *g* and *h* only once. If *k* be too faint then *g* and *h* must be symmetrically measured.

14. Same remarks apply as to July 13.

15. Do. do.

16. Parallax to depend on *k* and *e*, if *k* bright enough; if not, use *g* and *h*, as on July 13.

17. Endeavour to measure all stars; if only time for once, then in following order — *k*, *d*, *f*, *g*; if *k* too faint, measure *g* twice, thus—*d*, *g*, *g*, *f*.

18. Same as on 17th.

19. If *k* bright enough, use *k*, *c*, and *β*; if not, measure *f*—*d*, P—*d*, P—*f*.

July 20. Endeavour to measure all these in the following order:

21. Measure *α*, *b*, *c*, *β*.

22. Same as 21st.

23. Measure *c*, *e*, *α*, and *d*.

24. Measure *c*, *e*, *d*, and *h*.

25. Measure *a*, *e*, *d*, and *b*.

26. Parallax depends on *a* and *e*; measure *b* once only.

27. Same as 26th.

28. Same as 26th.

29. Measure *a* twice; *b* and *c* once each.

30. Same as 29th.

31. Measure position-angles also.

Aug. 1. Same as 31st.

Nébuleuses nouvelles découvertes et observées à l'Observatoire de Marseille. Par M. E. Stephan.

Positions moyennes pour 1876·0.

N° d'ordre.	* de comp.	Ascensions droites. h	m	s	Distances polaires. °	′	″	Description sommaire.
1	*a*	0	33	17·56	87	8	41·6	Excessivement excessivement faible ; excessivement petite ; quelques petits points brillants visibles par intermittences.
2	*b*	0	34	36·47	87	14	27·1	Noyau nébuleux excessivement excessivement faible et petit.
3	*c*	0	35	48·42	54	21	6·9	Excessivement excessivement faible ; excessivement petite ; ronde ; graduellement condensée au centre ; un très-petit point brillant à peu près central.
4	*d*	1	16	58·47	79	21	25·3	Excessivement excessivement faible ; aspect vaporeux ; très-petite ; enveloppe une très-petite * ; en touche une autre 14–15ème.
5	*e*	1	24	1·87	69	12	2·1	Excessivement excessivement faible ; presque inobservable ; irrégulièrement arrondie ; diamètre = $\frac{3}{4}$ de 1′ environ.
6	*f*	1	31	10·20	55	15	56·8	Excessivement excess. faible et petite ; enveloppe plusieurs très-petites *.
7	*g*	1	53	9·86	59	17	25·5	Excessivement excessivement faible ; très-petite ; ronde ; un peu de condensation centrale.
8	*h*	1	53	55·49	58	43	4·2	Excessivement excessivement faible ; petite ; aspect vaporeux ; irrégulièrement arrondie ; très-petit point brillant ; touche très-petite *.
9	*h*	1	54	28·84	58	46	26·7	Excessivement excessivement faible et petite ; enveloppe une très-petite *.
10	*i*	2	48	52·52	90	41	17·4	10 et 11 sont accolées et forment une sorte de nébuleuse à 2 noyaux ; elles sont à peu près identiques ; toutefois 10 est un peu plus faible que 11. Toutes deux excessivement excessivement faibles et petites ; rondes avec condensation centrale.
11	*i*	2	48	49·77	90	41	1·0	
12	*j*	21	20	8·87	97	31	53·1	Excessivement excess. faible et petite ; ronde ; très-petit point brillant central.
13	*k*	22	16	10·81	94	44	41·4	Excessivement excessivement faible ; irrégulièrement arrondie ; diamètre = $\frac{1}{2}$ 1′ environ ; trace de condensation centrale.

14	*k*	22	16	57·19	54	24	39·3	Faible; très-petite; ronde; forte condensation centrale.
15	*l*	22	18	38·39	54	25	34·2	15, 16 et 17 ont à peu près le même aspect que 14; 15 est un peu plus faible et plus petite; 16 est un peu plus brillante et moins petite; 17 est notablement plus faible et plus petite.
16	*l*	22	18	40·04	54	30	4·0	
17	*l*	22	18	43·19	54	32	21·8	
18	*m*	22	22	28·50	73	51	1·6	Excessivement excessivement faible et petite; ronde; légère condensation centrale, avec un très-petit point brillant à peu près central.
19	*n*	22	30	13·70	56	41	46·8	Les quatre nébuleuses 19, 20, 21 et 22 sont excessivement excessivement faibles; excessivement petites; très-difficilement observables. La plus belle est 19; puis viennent 20, 21, 22. Cependant 22, quoique la plus petite des quatre, est plus brillante.
20	*n*	22	30	19·22	56	40	30·7	
21	*n*	22	30	24·27	56	39	52·4	
22	*n*	22	30	24·92	56	41	35·2	
23	*o*	22	32	56·70	56	34	23·6	Excessivement excessivement faible; excessivement petite; ronde; un peu de condensation centrale enveloppe quelques très-petites étoiles.
24	*p*	22	41	56·69	50	24	56·1	Excessivement excess. faible; très-petite; ronde; légère condensation centrale.
25	*q*	22	52	44·36	54	51	38·6	Excessivement excess. faible; très-petite; irrégulièrement arrondie; condensation centrale mal définie; plusieurs très-petits points brillants.
26	*r*	22	55	23·47	88	24	12·3	Excessivement excessivement faible, à peine observable; ronde D = 1″·5; condensation centrale à peine sensible.
27	*s*	23	6	32·63	55	47	6·2	Excessivement excess. faible, à peine observable; irrégulièrement arrondie D = 45″; condensation à peine sensible; quelques points br. soupçonnés.
28	*t*	23	10	18·64	66	10	44·5	Excessivement excessivement faible; modérément étendue; irrégulièrement arrondie; enveloppe plusieurs très-petites étoiles.
29	*u*	23	20	30·76	65	36	4·9	Excessivement excessivement faible et petite; irrégulièrement arrondie; une peu de condensation centrale; enveloppe un très-petite ✶.
30	*v*	23	46	55·11	62	24	19·5	Excessivement faible et petite; ronde; condensation centrale.

Le No. 12 est peut-être identique avec 440 Lassell.
14, 15, 16, 17 sont voisines de 474 et 475 Lassell, mais distinctes de celles-ci.

Positions Moyennes des Étoiles de Comparaison pour 1876·0.

*	Noms des étoiles.	Ascensions droites.	Distances polaires.	Autorité.
		h m s	° ′ ″	
a	88 Arg. Z+ 2	0 34 58·59	87 4 54·1	A. Cat. de Weisse, N° 583 H. 0.
b	92 Arg. Z+ 2	0 35 40·27	87 12 57·8	1 obs. méridienne.
c	129 Arg. Z+35	0 35 47·97	54 20 24·6	1 obs. mérid.
d	169 Arg. Z+10	1 15 9·61	79 22 41·1	A. Cat. de Weisse, N° 215 H. 1.
e	236 Arg. Z+20	1 26 2·34	69 15 16·8	1 obs. mérid.
f	290 Arg. Z+34	1 32 34·98	55 18 56·5	1 obs. mérid.
g	311 Arg. Z+30	1 50 58·19	59 18 54·1	1 obs. mérid.
h	359 Arg. Z+31	1 56 24·64	58 42 32·1	1 obs. mérid.
i	456 Arg. Z 0	2 49 49·87	90 42 8·0	1 obs. mérid.
j	451 W. (*a.c.*); H. xxi.	21 20 49·09	97 32 58·0	A. Cat. de Weisse, N° 451 H. xxi.
k	238 W. (*a.c.*); H. xxii.	22 13 23·06	94 41 11·3	A. Cat. de Weisse.
l	4794 Arg. Z+35	22 19 50·96	54 27 3·0	1 obs. mérid.
m	4744 Arg. Z+16	22 21 37·95	73 51 21·7	1 obs. mérid.
n	4531 Arg. Z+33	22 27 36·57	56 41 38·3	A. Cat. de Weisse, N° 584 H. xxii.
o	4561 Arg. Z+33	22 34 26·29	56 32 14·0	1 obs. mérid.
p	4953 Arg. Z+39	22 46 41·51	50 23 35·0	Cat. de Groombr., N° 3908.
q	4942 Arg. Z+35	22 55 3·89	54 49 35·5	1 obs. mérid.
r	4674 Arg. Z+ 1	22 56 35·72	88 26 31·3	1 obs. mérid.
s	4858 Arg. Z+34	23 4 55·10	55 50 14·5	1 obs. mérid.
t	4711 Arg. Z+23	23 9 35·13	66 15 6·5	2 obs. mérid.
u	4766 Arg. Z+24	23 18 5·34	65 40 7·4	1 obs. mérid.
v	4641 Arg. Z+27	23 48 38·58	62 27 36·3	1 obs. mérid.

Nébuleuses nouvelles découvertes et observées à l'Observatoire de Marseille. Par M. E. Stephan.

Positions moyennes pour 1877·0.

N° d'ordre.	✶ de comp.	Ascensions droites. h	m	s	Distances polaires. °	′	″	Description sommaire.
1	*a*	1	21	10·60	92	32	57·4	1 et 2 ont à peu près le même aspect; toutes deux sont excessivement excessivement faibles et petites; rondes; condensation centrale; 2 un peu moins faible que 1.
2	*a*	1	21	32·62	92	30	55·8	
3	*b*	1	59	11·68	46	0	51·8	Excessivement excess. faible; forme d'un mince fuseau à 45° avec le méridien longueur 1′·5 environ; léger noyau de condensation; observation difficile.
4	*c*	2	4	29·53	46	0	42·0	Excessivement excess. faible et petite; ronde; condensation centrale graduelle.
5	*d*	2	24	56·09	55	3	3·8	Excessivement excessivement faible; un peu ovoïde; grand diamètre = 1′·25 environ; faible condensation à peu près centrale.
6	*e*	2	31	37·87	101	33	35·1	Excessivement excessivement faible; très-petite; ronde; pas de condensation (á peine observable).
7	*e*	2	31	41·11	101	32	24·6	Plus faible que 6; très-petite; ronde; un petit point de condensation centrale.
8	*f*	2	41	11·89	85	52	34·6	Excessivement excessivement faible; très difficile à observer; petite; ronde; D = 0′·7; traces de condensation.
9	*f* et *g*	2	41	48·66	85	56	10·2	Excessivement faible; excessivement excessivement petite; ronde; belle condensation centrale; précédée de 2′ par une ✶ 13ème sur même parallèle.
10	*h*	2	52	16·74	100	50	3·93	10 et 11 sont excessivement excessivement faibles; très-petites; rondes avec un peu de condensation centrale; 10 un peu moins faible que 11.
11	*h*	2	52	11·26	100	51	26·5	
12	*i*	3	24	8·69	95	57	50·1	Excessivement excessivement faible et petite; ronde; condensation centrale; suit de 2ᵐ·2 une ✶ 13ème.
13	*j*	3	54	49·09	67	12	48.5	Excessivement excess. faible; excessivement petite; irrégulièrement arrondie; légère condensation; une très-petite ✶ se projette sur la nébuleuse.

N° d'ordre.	✶ de comp.	Ascensions droites. h	m	s	Distances polaires. °	′	″	Description sommaire.
14	*k*	3	58	22·39	64	55	45·0	Excessivement faible et petite ; ronde ; condensation centrale ; assez marquée; paraît résoluble.
15	*l*	4	22	14·81	95	27	13·8	Excessivement faible et petite ; ronde ; paraît résoluble.
16	*m*	4	48	12·07	86	55	59·9	Très-faible et très-petite ; nébulosité enveloppant une ✶ 11ème.
17	*n*	5	8	18·65	100	46	12·1	Tres-faible ; et très-petite ; ronde ; légère condensation centrale.
18	*o*	5	57	41·25	99	43	46·8	Très-légère nébulosité enveloppant une ✶ 12ème.
19	*p*	7	1	20·16	45	20	52·6	Excessivement excessivement faible ; très-petite ; irrégulière ; allongée.
20	*q*	7	27	6·24	56	54	43·0	Excessivement excessivement faible ; excessivement petite ; enveloppe plusieurs très-petites ✶.
21	*r*	7	29	30·56	71	50	46·0	Excessivement faible ; excessivement excess. petite ; condensation centrale.
22	*s*	7	38	34·65	50	40	17·8	22 et 23 sont deux petits noyaux nébuleux excessivement excess. faibles ; 23 est beaucoup plus faible que 22, et touche au S. une très-petite ✶.
23	*s*	7	38	37·07	50	41	17·3	
24	*t*	7	59	56·34	50	29	19·2	Excessivement faible ; très-petite ; trace de condensation.
25	*t*	8	0	52·61	50	31	16·4	Faible ; petite ; ronde ; condensation centrale.
26	*u*	8	3	49·90	64	25	54·8	26 et 27 sont excessivement excess. faibles ; à peine observables ; excess. petites ; rondes ; 26 est la plus faible des deux.
27	*u*	8	3	52·10	64	27	30·6	
28	*v*	8	4	56·13	86	0	8·7	Excessivement faible et petite ; ronde ; condensation centrale ; bien marquée.
29	*w*	8	11	58·72	68	9	58·6	Excessivement excess. faible et petite ; ronde ; faible condensation centrale.
30	*x*	8	14	19·27	70	27	51·1	Excessivement excess. faible ; très-petite ; irrégulière ; aspect vaporeux ; touche une ✶ 13ème.

Nota.—L'une de nébuleuses 1 ou 2 est peut-être identique avec l'une des deux 332, 333, J. F. W. Herschel.

Positions Moyennes des Étoiles de Comparaison pour 1877·0.

*	Noms des étoiles.	Ascensions droites. h m s	Distances polaires. ° ′ ″	Autorité.
a	343 W. (*a.c.*); H. 1.	1 21 42·13	92 37 22·9	Cat. Weisse.
b	425 Arg. Z+43°	1 58 16·16	46 1 1·5	1 observation méridienne.
c	451 Arg. Z+43	2 6 34·78	45 59 39·5	1 obs. mérid.
d	473 Arg. Z+34	2 28 50·69	55 3 15·7	1 obs. mérid.
e	Anonyme	2 30 8·04	101 30 7·3	1 obs. mérid.
f	449 Arg. Z+ 4	2 43 35·74	85 53 15·4	1 obs. mérid.
g	388 Arg. Z+ 3	2 42 47·16	85 57 16·3	1 obs. mérid.
h	875 W. (*a.c.*); H. ii.	2 50 58·21	100 52 14·4	1 obs. mérid.
i	391 W. (*a.c.*); H. iii.	3 23 20·31	95 58 38·9	Cat. Weisse.
j	610 Arg. Z+22	3 51 3·56	67 14 55·5	1 obs. mérid.
k	671 Arg. Z+25	3 57 29·79	64 53 59·4	1 obs. mérid.
l	386 W. (*a.c.*); H. iv.	4 19 39·54	95 26 4·1	Cat. W.
m	716 Arg. Z+ 3	4 50 32·72	86 54 33·8	Cat. W. (*a.c.*), N° 1080 H. iv.
n	135 W. (*a.c.*); H. v.	5 7 33·53	100 46 52·9	Cat. W.
o	1556 W. (*a.c.*); H. v.	6 1 8·77	99 43 33·3	Cat. W.
p	1596 Arg. Z+44	7 2 21·66	45 19 28·3	1 obs. mérid.
q	1554 Arg. Z+33	7 28 18·24	56 53 32·0	1 obs. mérid.
r	1670 Arg. Z+18	7 28 8·39	71 52 38·6	1 obs. mérid.
s	2012 Arg. Z+39	7 41 9·50	50 41 34·8	1 obs. mérid.
t	2062 Arg. Z+39	8 1 37·61	50 33 24·4	1 obs. mérid.
u	1872 Arg. Z+25	8 4 40·40	64 27 18·6	1 obs. mérid.
v	1920 Arg. Z+ 4	8 3 14·06	86 1 51·1	1 obs. mérid.
w	1798 Arg. Z+21	8 8 18·87	68 12 48·5	1 obs. mérid.
x	2004 Arg. Z+19	8 17 44·49	70 26 1·4	2 obs. mérid.

Observations of Occultations of Stars by the Moon, 1875, 6, 7 (*with the deduced Equations between the Errors of the Lunar Elements*); *and of the Phenomena of Jupiter's Satellites, made at the Radcliffe Observatory, Oxford; continued from Vol. XXXV. No.* 8, *of the "Monthly Notices."*

(*Communicated by the Radcliffe Observer.*)

No.	Day and Year of Observation.	Name of Object.	Phenomenon.	☽'s Limb.	Oxford Mean Solar Time. h m s	Observer.
	1875.					
1	Oct. 24	σ Leonis	Disapp.	Bright	17 31 54·4	F. B.
2	„	„	Reapp.	Dark	18 20 32·3	„
3	Nov. 8	χ Aquarii	Disapp.	Dark	9 20 45·4	K.
4	Dec. 9	19 Arietis	Disapp.	Dark	5 59 46·5	K. & F. B.
	1876.					
5	Jan. 3	Lamont 23	Disapp.	Bright	7 38 32·7	L.
6	„	„	Reapp.	Bright	7 40 33·4	„
7	Feb. 2	27 Arietis	Disapp.	Dark	6 22 59·4	K. & F. B.
8	„	„	Reapp.	Bright	7 27 32·3	F. B.
9	March 4	B.A.C. 2097	Disapp.	Dark	10 54 58·4	K.
10	April 1	47 Geminorum	Disapp.	Dark	7 27 7·1	L. & F. B.
11	„	W.B. (2) VII. 81, 2	Disapp.	Dark	7 41 37·7	L. & F. B.
12	„ 7	B.A.C. 4225	Disapp.	Dark	8 22 52·9	L.
13	„	*f* Virginis	Disapp.	Dark	11 31 47·7	L. & F. B.
14	July 13	ϵ Piscium	Disapp.	Bright	13 0 46·6	F. B.
15	„	„	Reapp.	Dark	13 54 28·9	„
16	„ 16	23 Tauri	Disapp.	Bright	14 26 51·1	„
17	„	24 Tauri	„	„	14 57 45·4	„
18	„	η Tauri	„	„	14 59 17·3	„
19	„	23 Tauri	Reapp.	Dark	15 21 17·1	„
20	„	27 Tauri	Disapp.	Bright	15 33 14·9	„
21	„	26 Tauri	„	„	15 35 1·8	„
22	„	28 Tauri	„	„	15 35 44·7	„
23	„	η Tauri	Reapp.	Dark	15 52 12·1	„
24	Nov. 29	47 Arietis	Disapp.	Dark	7 51 1·9	L. & H. B.
	1877.					
25	Jan. 30	ρ Leonis	Disapp.	Bright	10 45 15·1	L.
„	„	„	„	„	10 45 15·8	H. B.
26	„	„	Reapp.	Dark	11 50 38·0	L.
27	Feb. 26	Regulus	Disapp.	Dark	12 39 1·8	L.
„	„	„	„	„	12 39 0·4	F. B.
28	„	„	Reapp.	Bright	13 44 41·0	L.
„	„	„	„	„	13 44 40·9	F. B.

Notes.

No. 1. σ *Leonis*, disapp. The star seemed to hang on the Moon's limb for 3 or 4 seconds, but ultimately disappeared instantaneously.

„ 2. „ reapp. The observation doubtful; I turned round to verify my counting, and, on again looking in the telescope, the star seemed to reappear at that moment.

„ 4. 19 *Arietis*, disapp. The time noted is that at which I last saw the star, which seemed to disappear behind a dense cloud. (K.)

„ 7. 27 *Arietis*, disapp. The disappearance was instantaneous and the observation good; the unilluminated disk of the Moon was distinctly visible. (K.)

„ 8. „ reapp. At the reappearance the star was faint; the time noted is thought to be certainly within $0^s.5$; the Moon's motion in N.P.D. was very rapid. (F.B.)

„ 10, 11. 47 *Geminorum*, disapp., and W.B. (2) VII. 81, 2, disapp. Instantaneous; the unilluminated disk of the Moon distinctly visible. (F.B.) The R.A. and N.P.D. of W.B. (2) VII. 81, 2 are obtained from three observations made in 1877.

„ 12. B.A.C. 4225, disapp. Doubtful to a second.

„ 13. *f Virginis*, disapp. The star very faint just previous to disappearance. (Both observers.)

„ 14. ϵ *Piscium*, disapp. The star appeared to hang for a few seconds on the Moon's limb, and then disappeared behind a projection.

„ 15. „ reapp. I am very doubtful about this time; probably too late.

„ 17. 24 *Tauri*, disapp. Faint at disappearance.

„ 18, 20. η *Tauri*, disapp, and 27 *Tauri*, disapp. At both these phenomena the star hung on the Moon's limb for 2^s, and overlapped it (the colour of the star being plainly distinguished from that of the Moon), and then disappeared instantaneously.

„ 21. 26 *Tauri*, disapp. Star very faint; observation doubtful.

„ 22. 28 *Tauri*, disapp. Disappearance instantaneous.

„ 23. η *Tauri*, reapp. The reappearance had taken place at the time noted, when I just saw it at the edge of the field of the telescope.

„ 25. ρ *Leonis*, disapp. and reapp. Unsteady; windy. (L.)

„ 27. *Regulus*, disapp. Disappearance instantaneous. (Both observers.)

In the following table of the errors of lunar elements resulting from the occultations, the Greenwich notation is used, and the elements of the *Nautical Almanac* are used uncorrected. All the computations have been made by Mr. Main by the method given in his treatise on *Spherical and Practical Astronomy*.

The observations are referred to by the Nos. of reference given above.

No.								
1	$+11''.30 = +0.6802 \times e$	$-0.2425 \times f$	$-0.6802 \times x$	$+0.2427 \times y$	$-0.2026 \times t$	$-0.5396 \times m$	$-0.9210 \times n$
2	$-11.32 = -0.2003 \times e$	$-0.9794 \times f$	$+0.2003 \times x$	$+0.9794 \times y$	$+0.3038 \times t$	$+2.6554 \times m$	$-0.9207 \times n$
3	$+3.15 = +0.8910 \times e$	$+0.4384 \times f$	$-0.8910 \times x$	$-0.4388 \times y$	$-0.1956 \times t$	$-0.6335 \times m$	$-0.9462 \times n$
4	$+9.65 = +0.6204 \times e$	$-0.7656 \times f$	$-0.6204 \times x$	$+0.7662 \times y$	$-0.4953 \times t$	$+0.7812 \times m$	$-0.9885 \times n$
5	$-5.95 = -0.5388 \times e$	$-0.8423 \times f$	$+0.5388 \times x$	$+0.8423 \times y$	$-0.0272 \times t$	$+1.5823 \times m$	$-0.9379 \times n$
6	$-4.22 = -0.5856 \times e$	$-0.8105 \times f$	$+0.5856 \times x$	$+0.8105 \times y$	$-0.0026 \times t$	$+1.4311 \times m$	$-0.9379 \times n$
7	$+3.20 = +0.9480 \times e$	$+0.0988 \times f$	$-0.9480 \times x$	$-0.0974 \times y$	$-0.3509 \times t$	$+0.2551 \times m$	$-0.9593 \times n$
8	$-8.36 = -0.5222 \times e$	$+0.8363 \times f$	$+0.5222 \times x$	$-0.8359 \times y$	$+0.3814 \times t$	$-2.2871 \times m$	$-0.9597 \times n$
9	$+7.72 = +0.5331 \times e$	$-0.7937 \times f$	$-0.5331 \times x$	$+0.7945 \times y$	$-0.2254 \times t$	$+2.4694 \times m$	$-0.9728 \times n$
10	$+1.82 = +0.0979 \times e$	$+0.9938 \times f$	$-0.0979 \times x$	$-0.9938 \times y$	$-0.1504 \times t$	$-1.4320 \times m$	$-0.9689 \times n$
11	$+10.64 = +0.7904 \times e$	$-0.4482 \times f$	$-0.7904 \times x$	$+0.4502 \times y$	$-0.3753 \times t$	$+1.3358 \times m$	$-0.9689 \times n$
12	$+5.93 = -0.1375 \times e$	$+0.9905 \times f$	$+0.1375 \times x$	$-0.9905 \times y$	$-0.2164 \times t$	$-2.5444 \times m$	$-0.9305 \times n$
13	$+9.02 = +0.6400 \times e$	$+0.7668 \times f$	$-0.6400 \times x$	$-0.7670 \times y$	$-0.4068 \times t$	$-2.1331 \times m$	$-0.9293 \times n$
14	$+7.23 = +0.9904 \times e$	$+0.0066 \times f$	$-0.9904 \times x$	$-0.0060 \times y$	$-0.4202 \times t$	$-1.9663 \times m$	$-0.9342 \times n$
15	$(-16.44) = -0.4036 \times e$	$+0.9132 \times f$	$+0.4036 \times x$	$-0.9131 \times y$	$+0.4040 \times t$	$-1.5849 \times m$	$-0.9347 \times n$
16	$(+28.23) = +0.7560 \times e$	$-0.5592 \times f$	$-0.7560 \times x$	$+0.5606 \times y$	$-0.5870 \times t$	$-3.1938 \times m$	$-0.9765 \times n$
19	$-2.86 = -0.9002 \times e$	$+0.1621 \times f$	$+0.9002 \times x$	$-0.1601 \times y$	$+0.5468 \times t$	$+1.6832 \times m$	$-0.9770 \times n$

17	+ 0·83	= + 0·5623 × *e*	− 0·7866 × *f*	− 0·5623 × *x*	+ 0·7874 × *y*	− 0·5064 × *t*	+ 0·5069 × *m*	− 0·9768 × *n*
18	+ 7·24	= + 0·6224 × *e*	− 0·7301 × *f*	− 0·6224 × *x*	+ 0·7311 × *y*	− 0·5282 × *t*	+ 0·2325 × *m*	− 0·9768 × *n*
23	− 0·49	= − 0·9113 × *e*	− 0·0108 × *f*	+ 0·9113 × *x*	+ 0·0130 × *y*	+ 0·4977 × *t*	+ 1·9306 × *m*	− 0·9773 × *n*
20	− 2·72	= + 0·8974 × *e*	− 0·1743 × *f*	− 0·8974 × *x*	+ 0·1763 × *y*	− 0·5425 × *t*	− 1·6254 × *m*	− 0·9771 × *n*
21	− 2·35	= + 0·6934 × *e*	+ 0·6430 × *f*	− 0·6934 × *x*	− 0·6418 × *y*	− 0·2498 × *t*	− 2·9640 × *m*	− 0·9771 × *n*
22	+ 3·96	= + 0·8468 × *e*	− 0·3687 × *f*	− 0·8468 × *x*	+ 0·3705 × *y*	− 0·5563 × *t*	− 1·0790 × *m*	− 0·9771 × *n*
24	+ 9·40	= + 0·9332 × *e*	+ 0·0671 × *f*	− 0·9332 × *x*	− 0·0653 × *y*	− 0·4115 × *t*	− 1·4271 × *m*	− 0·9709 × *n*
25	+ 10·04	= + 0·9085 × *e*	+ 0·3815 × *f*	− 0·9085 × *x*	− 0·3807 × *y*	− 0·5078 × *t*	− 2·4465 × *m*	− 0·9872 × *n*
26	− 9·99	= − 0·7485 × *e*	− 0·6480 × *f*	+ 0·7485 × *x*	+ 0·6486 × *y*	+ 0·4860 × *t*	+ 2·4259 × *m*	− 0·9868 × *n*
27	+ 12·98	= + 0·8393 × *e*	+ 0·5066 × *f*	− 0·8393 × *x*	− 0·5058 × *y*	− 0·4928 × *t*	− 0·6266 × *m*	− 0·9988 × *n*
28	− 10·29	= − 0·7653 × *e*	− 0·6180 × *f*	+ 0·7653 × *x*	+ 0·6188 × *y*	+ 0·5145 × *t*	+ 0·5042 × *m*	− 0·9987 × *n*

Phenomena of Jupiter's Satellites.

No.	Day and Year of Obs.	Satellite.	Phenomenon.	Phase of Phenomenon.	Instrument.	Oxford Mean Solar Time of Observation. h m s	Greenwich Mean Solar Time from *N.A.* h m s	Observer
	1875.							
1	June 28	I	Occ. disapp.	First contact	10-foot	10 21 36·3		K.
	,,	,,	,,	Bisection	,,	10 23 6·1	10 31	,,
	,,	,,	,,	Last cont.	,,	10 27 5·4		,,
2	,,	II	Occ. disapp.	Bisection	,,	11 0 0·1		,,
	,,	,,	,,	Last cont.	,,	11 2 29·7	11 7	,,
	1876.							
3	May 8	I	Ecl. disapp.	Last seen	,,	12 17 8·1	12 21 55·9	L.
4	,, 9	I	Shad. egr.	Last seen	,,	11 32 21·7	11 40	,,
5	,,	I	Tr. egr.	First cont.	,,	11 41 20·2		,,
	,,	,,	,,	Last cont.	,,	11 46 59·4	11 51	,,
6	,, 13	II	Ecl. disapp.	Last seen	Heliom.	9 30 33·8	9 35 36·2	F. B.
7	,,	II	Occ. reapp.	First seen	10-foot	12 9 23·9		L.
	,,	,,	,,	Last cont.	,,	12 14 23·1		,,
	,,	,,	,,	First seen	Heliom.	12 8 48·0	12 17	F. B.
	,,	,,	,,	Last cont.	,,	12 13 27·2		,,
8	,, 16	I	Trs. ingr.	First cont.	10-foot	11 12 39·5		L.
	,,	,,	,,	Last cont.	,,	11 17 8·7	11 23	,,
9	,, 20	II	Occ. disapp.	First cont.	,,	11 53 29·3		,,
	,,	,,	,,	Last cont.	,,	11 58 28·5		,,
	,,	,,	,,	First cont.	Heliom.	11 52 44·1	12 1	F. B.
	,,	,,	,,	Bisection	,,	11 56 13·5		,,
	,,	,,	,,	Last cont.	,,	11 59 13·0		,,
10	,, 21	III	Trs. ingr.	First cont.	10-foot	12 45 32·7		L.
	,,	,,	,,	Last cont.	,,	12 58 50·5	13 2	,,
11	,, 29	II	Trs. egr.	First cont.	,,	11 39 47·0		,,
	,,	,,	,,	Last cont.	,,	11 49 15·4		,,
	,,	,,	,,	First cont.	Heliom.	11 40 26·4	11 49	F. B.
	,,	,,	,,	Bisection	,,	11 43 16·0		,,
	,,	,,	,,	Last cont.	,,	11 46 0·6		,,
12	,,	II	Shad. egr.	First cont.	10-foot	12 12 11·7		L.
	,,	,,	,,	Last cont.	,,	12 16 41·0	12 26	,,
13	,, 31	I	Occ. disapp.	First cont.	,,	12 3 12·2		L.
	,,	,,	,,	Bisection	,,	12 4 41·9		,,
	,,	,,	,,	Last cont.	,,	12 6 41·6	12 11	,,
	,,	,,	,,	First cont.	Heliom.	12 1 20·5		F. B.
	,,	,,	,,	Last cont.	,,	12 7 24·5		,,

No.	Day and Year of Obs.	Satellite.	Phenomenon.	Phase of Phenomenon.	Instrument.	Oxford Mean Solar Time of Observation. h m s	Greenwich Mean Solar Time from *N.A.* h m s	Observer.
14	June 1 1875.	III	Ecl. reapp.	...	Heiom.	9 10 1·4	9 16 24·5	F. B.
15	,,	I	Trs. ingr.	First cont.	,,	9 10 52·3		,,
	,,	,,	,,	Bisection	,,	9 12 7·1	9 18	,,
	,,	,,	,,	Last cont.	,,	9 14 21·8		,,
	,,	,,	,,	Last cont.	10-foot	9 16 9·6		L.
16	,,	I	Shad. ingr.	Last cont.	,,	9 39 15·8		,,
	,,	,,	,,	Bisection	Heliom.	9 36 32·4	9 39	F. B.
	,,	,,	,,	Last cont.	,,	9 38 17·2		,,
17	,,	I	Trs. egr.	First cont.	10-foot	11 17 40·8		L.
	,,	,,	,,	Last cont.	,,	11 23 49·8	11 29	,,
	,,	,,	,,	First cont.	Heliom.	11 21 45·1		F B.
	,,	,,	,,	Last cont.	,,	11 24 59·6		,,
18	,,	I	Shad. egr.	First cont.	,,	11 37 53·5	11 51	,,
	,,	,,	,,	Last cont.	10-foot	11 41 27·0		L.
19	,, 14	II	Ecl. reapp.	First seen	,,	11 41 22·1		,,
	,,	,,	,,	Fully seen	,,	11 41 56·5	11 48 27·6	,,
	,,	,,	,,	First seen	Heliom.	11 41 18·1		F. B.
20	July 3	III	Trs. egr.	Bisection	10-foot	10 57 57·4		L.
	,,	,,	,,	Last cont.	,,	11 7 55·8		,,
	,,	,,	,,	First cont.	Heliom.	10 51 16·5	11 10	F. B.
	,,	,,	,,	Bisection	,,	10 57 30·6		,,
	,,	,,	,,	Last cont.	,,	11 2 59·7		,,
21	,, 14	III	Ecl. reapp.	First seen	10-foot	9 3 36·9	9 12 8·0	L.
	,,	,,	,,	Fully seen	,,	9 4 11·8		,,
22	Aug. 1	II	Trs. egr.	First cont.	,,	9 0 22·2	9 5	,,
	,,	,,	,,	Last cont.	,,	9 6 1·3		,,
23	,,	I	Occ. disapp.	First cont.	,,	9 50 45·7	9 57	,,
	,,	,,	,,	Last cont.	,,	9 53 35·2		,,
24	,, 8	II	Trs. ingr.	First cont.	,,	8 58 25·8	9 1	,,
	,,	,,	,,	Last cont.	,,	9 0 30·5		,,
25	,, 9	I	Trs. ingr.	First cont.	Heliom.	8 54 51·0	9 3	F. B.
	,,	,,	,,	Last cont.	,,	8 59 20·3		,,
26	,, 10	II	Ecl. reapp.	First seen	,,	8 39 50·9	8 46 59·5	,,

Notes.

No.

1 Cloudy.

2 The satellite very faint; cloudy.

3 The satellite was at least 20ˢ passing into the shadow, which was almost coincident with the limb of the planet.

4 The shadow was very faint, only seen at intervals, but the time noted is supposed to be very near the last contact; windy during the observation.

6 The satellite had been fading in brightness and was almost in contact with the planet when I last saw it.

8 Unsteady; at the last contact the satellite seemed to be on the planet and to jump off again.

10 The satellite at last contact moved along the limb of the planet for more than half an hour, the two limbs being in contact at $13^h\ 21^m$; I did not think to look for the shadow till that time, when I was surprised to find it fully on the disk of the planet, with the limb just in contact. I thought every minute the satellite was coming off the planet, but on referring to the *Nautical Almanac* I found it would not do so for nearly two hours. Too tired to wait for the egress.

11 Uncertain. (L.)
The image of the planet very diffused. (F.B.)

12 Very doubtful. (L.)

13 Definition very bad. (L.)

14 Reappearance instantaneous.

16 Shadow very faint; probably the time noted is one minute too late. (L.)
The last contact is considered satisfactory. The times noted have been each diminished by five minutes. (F.B.)

17 The planet ill-defined; the satellite very faint. (Both observers.)

19 Very faint at reappearance. (L.)
Reappearance instantaneous, but the satellite faint owing to cloud. (F.B.)

20 Very unsteady and ill-defined; the satellite hung on the limb for some minutes after the last contact appeared to have taken place. (L.)
The planet was very tremulous, and the satellite seemed to hang on the limb for some minutes after last contact; at $11^h\ 12^m$ the satellite was quite detached from the limb. (F.B.)

22 The satellite faint.

24 Unsteady.

25 Cloudy during the observation; the planet was very badly defined and unsteady; the satellite seemed to jump away from it after the contact had taken place.

26 Cloudy during the observation; the satellite was very faint at the time of reappearance, and did not attain its usual brightness till one minute after.

The initials L., K., F.B., H.B. are those of Mr. Lucas, Mr. Keating, Mr. F. Bellamy, and Mr. H. Bellamy.

The instruments used were the heliometer with power of 200, and the 10-foot telescope with power of 160.

April 3, 1877.

The Planet Vulcan. By the Rev. S. J. Perry.

The weather was exceedingly favourable here for the search for the intermercurial planet, and a careful watch was maintained throughout the whole of the 21st, 22nd, and 23rd of March. The spider-line micrometer was used with the 8-inch achromatic, and the Sun's image, projected on a screen of very smooth white cardboard attached to the eye-end of the telescope, had a diameter of $9\frac{1}{8}$ inches. An excellent driving clock is attached to the Equatoreal. On the 21st of March the Sun was observed from 9.30 A.M. till 6.3 P.M. G.M.T. Passing clouds obscured the image

	m		h	m		h	m
twice for	10	beginning at	2	49	and at	5	40
twice ,,	15	,,	,, 11	31	,,	,, 3	1
once ,,	23	,,	,, 12	25			

On March 22 the watch was kept up from 7.0 A.M. till 6.10 P.M., with only five breaks of continuity, viz. for

	m		h	m
	12	beginning at	10	34
	14	,,	,, 11	48
	17	,,	,, 10	5
	20	,,	,, 2	8
and	24	,,	,, 12	25

On March 23, from 7.30 A.M. till 1 P.M., there was no interruption, but the Sun was obscured from 1 P.M. till $2^h\ 27^m$. Clouds also interfered for

m		h	m
10	beginning at	3	10
11	,,	,, 2	37
16	,,	,, 3	42

Observations were discontinued at 5.10 P.M. on account of the indistinctness of the image.

I have given above only the times when the Sun was obscured for at least 10^m; other lesser interruptions from small passing clouds were accurately noted, but it does not seem necessary to reproduce them here.

The definition on all three days was generally very good, and the atmosphere quite steady enough for good micrometric measurements. The faculæ around the double group of eight or nine spots on the western limb of the Sun, and the vast group of faculæ without any accompanying spot on the eastern side, were the only features that broke the monotony of the mottled surface during the whole period of observation.

These observations, combined with any other set taken under equally favourable circumstances in this country, would suffice to establish the fact that *Vulcan* did not pass across the solar disk whilst the Sun was above our horizon from the 21st to the 23rd of March 1877.

Stonyhurst Observatory,
1877, *March* 24.

Report of Examination of the Sun's Disk at Guildown, Guildford, on 21st, 22nd, and 23rd March 1877, *for the suspected planet Vulcan, with a* $3\frac{1}{4}$*-in. Cooke Refractor. Huyghenian eye-pieces* 20 *and* 50. *Transit eye-piece about* 40. By J. Rand Capron, Esq.

Wednesday, 21st March 1877.

9 to 10. Frequent examinations. Sun spot, with group of much smaller ones, well seen near edge of Sun.
10 to 2. Very cloudy, occasional glimpses of Sun's disk through clouds.
2 to 4. Brighter, but still cloudy, allowing of examinations from time to time; practised photo-plates with larger telescope ($8\frac{1}{4}$-inch reflector).

Thursday, 22nd March.

7.10. Sunrise in mist; small spot and faculæ seen on Sun's edge.
7.41. Less mist; spot plainer.
7.54. Mist breaking; Sun's limb sharp; spot and faculæ very distinct.
8.26. Still misty, but spot and faculæ well defined.
9.1., 9.33., 10.12. Sun getting above mist, with bright disk.
10.47. Light misty clouds, but spot well seen.
11.0., 11.35. Sun quite bright.
Four Kennett plates taken between 9.30 and 11.30 with reflector.
11.52. Sun clouded.
12.20. Kennett plate, No. 5.
12.50. Snow flakes seen crossing the Sun's disk; none fell below.
12.57. Snowdrift continued, and clouds came up.
2.26. Curious cloud shadows overhead.
2.39. Sun's reappearance with bright disk.

2.46. Kennett plate, No. 6.
2.52. Ditto „ 7.
3.30. Ditto „ 8.
3.34. Ditto „ 9.
} Small spot very close to Sun's edge.

Clouds and mist then came on.

5.25. Sun low; disk clear.

Friday, 23rd *March*.

6.58.
7.28.
7.55.
8.7.
8.47.
9.30.
10.0.
} Sharp frost; Sun rose in slight mist, which afterwards got denser; disk, however, well seen and quite clear.

10.18. Misty; fine Sun halo.
10.30. Disk clear.
11.0. Mist; wind freshening.
11.7. Disk clear.
11.38. Mist and wind; clouds coming up.
11.50. Clearer again.
12.33. Bright gleam; disk well seen and quite pure.
1.0. Glimpse among clouds.
1.45. Same.
1.48. Very bright glimpse.
2.52. Disk well seen through mist.
3.48. Same (with 20).
4.40. Sun in cloud and mist, but disk fairly seen with 20; wind high.
5.10. Fine Sun halo and Sun set in clouds.

Guildown, Guildford,
April 4, 1877.

Radiant Points of Shooting Stars. From Captain Tupman's unreduced Observations 1869–71.

By W. F. Denning, Esq., F.M.S.

(*Communicated by A. C. Ranyard, Esq., M.A.*)

The valuable observations of Shooting Stars by Captain Tupman in the years 1869–70–71, printed in 1873 for the British Association, contain a considerable number of meteor-paths that have not hitherto been reduced to their radiant points. Thus, between Jan. 21–Feb. 23 (1869) there are about 135, between Sept. 6–Oct. 13 (1869–71) 130, and between Dec. 12–23 (chiefly in 1869) 40 more, making about 300 altogether. These

I have projected upon an 18-inch globe, and traced their several radiant centres, as specified in the subjoined list of 20 such positions well-ascertained, and supplementary list of 8 others less certainly indicated. I have annexed the positions of other observers which they confirm, and the comparison shows that there is a very fair accordance in most cases. It should be mentioned that these new determinations are purely independent of and separate from Captain Tupman's older positions (*Monthly Notices*, vol. xxxiii. p. 300), having been deduced from other meteors seen on other nights; in fact, they are founded on different materials, though gathered by the same hand, and the two sets of positions compared together in the table, each possess a distinct value, whether confirmatory or otherwise. The chief shower in the new list is No. 2 at α 236° δ +11° (near α *Serpentis*) for Jan. 21–Feb. 23, which this year I confirmed in the same place, and was well observed by Captain Tupman Feb. 13, 1869, at 237° +13°. Nos. 11 and 16 were also active radiants. No. 13 (Sept.) at 105°+53° is not included in existing catalogues, though I found a position at 90° +58° for Oct. (No. 29 of my list [1876] of radiants, *Monthly Notices*, vol. xxxvii. p. 105). The average of the two comes out at 98°+56°, which is suspiciously near the radiant point of Donati's Comet (100° +59° Sept. 8) as computed by Professor Herschel (*see* B.A. Report, 1875, p. 233)*. Capt. Tupman describes the meteors as "very swift," and I find his estimate of the apparent velocity of 9 of them averaged 0·2 sec. for 10 degrees. I found them bright and rapid, leaving streaks. The fourth radiant in the supplementary list verifies a new and prominent shower I saw from near ψ *Cygni* in January last, and since confirmed by Prof. Heis at 297°+53° Jan. 1–21.

The shooting stars employed in the determination of these radiants do not include the *whole* of Capt. Tupman's unreduced paths. Between Nov. 3–12, 1869, there are 80 such observations, and in August 1870 a few more; but I have not gone over them, inasmuch as the chief systems (*Leonids* and *Taurids* in the former, and *Perseïds* and *Cassiopeïds* in the latter) common to those periods are already thoroughly well known by the able investigations of Mr. Greg and Prof. Herschel, of the British Association Luminous Meteor Committee.

* Since the above was written, I have examined many hundreds of meteor-paths recorded between Aug. 15–Oct. 15 by Capt. Tupman, Mr. Lucas (Radcliffe Observatory, Oxford), the Italian observers (Schiaparelli, Denza, and others, 1872), and myself, and found 33 meteors agreeing to a radiant at 99°+57° for September 1–15; while for the whole two months I have double that number from a general centre at 101°+57°. The accordance of this new shower in date and position with the nodal passage of Donati's Comet is remarkable, though possibly accidental and showing no real affinity of origin. —W. F. D.

List of 20 Radiant Points of Shooting Stars, deduced from Captain Tupman's Observations, 1869–71, not previously utilised.

	No. T. & D. 1877.	No. Tupman. 1873.	No. Greg. 1874.	Radiant-Point (T. & D. 1877). R.A. °	Dec. °	No. of ✓ s	Confirmations and Comparisons. T. (Tupman), G. and H. (Greg and Herschel), S. (Schmidt), S. and Z. (Schiaparelli and Zezioli), N. (Neumayer), H. (Heis), D. (Denning).
Jan. 21 to Feb. 23.	1	16–21	27	261	+ 4	8	T. 260° ±0°, Feb. 13; T. 266° +6° March 14–15.
	2	10	41	236	+11	20	T. 237 +13, Feb. 13; D. 236 +11, Feb.
	3	23	41	245	−22	9	T. 236 −13, March 2–3; T. 233 −18, March 7.
	4	11–17	44	209	−27	10	T. 204 −31, March 11–19; T. 202 −28, March 19.
	5	15	53	228	− 4	8	T. 230 −7, Feb. 13; G. and H. 227 −5, March–May.
	6	11–13	20	188	−26	8	T. 198 −22, Feb. 3–10; T. 180 −20, Feb. 8–10.
	7	6	8	204	−10	10	T. 202 −9, Feb. 13; T. 200 −10, March 2–3.
	8	17	44	218	−37	8	T. 217 −41, Feb. 22; N. 192 −38, March.
	9	2	28	174	+13	5	T. 175 +16, Feb. 3–10; G. and H. 175 +10, Feb.–March.
	10	10–25?	18	228	+29	11	G. and H. 233 +34, Jan. 28–29; D. 234 +32, Jan.–Feb.
Sept. 6 to Oct. 4 (chiefly).	11	78	{138 164}	59	− 9	13	T. 54 −14, Oct. 5–6; S. 55 −6, Sept. Eridanids.
	12	79	157	90	+19	8	T. 91 +18, Oct. 17; S. 93 +17, Oct. Orionids.
	13	...	...	105	+53	10	D. 90 +58, Oct. 14–15; new shower?
	14	68–69	114	50	+46	10	T. 45 +48, Sept. 5; S. 50 +48, Aug. 3–12.
	15	...	109	340	−14	7	S. 331 −13, Aug.–Sept.; N. 347 −11, Oct.
	16	93	150	28	+12	12	S. 22 +5, Aug.–Sept.; D. 27 +11, Sept.–Oct.
	17	75	{115 117}	54	+16	8	T. 62 +9, Sept. 14; S. 51 +14, Sept.
	18	82–80	{155 153}	{113 98}	{+11 −10}	10	{T. 107 +12, Oct. 8 T. 92 −14, Oct. 12} T. 101 ±0, Oct. 16.
	19	62	121	24	+36	8	T. 23 +36, Aug. 23; H. 23 +40, Oct.; S. & Z. 28 +36, Sept. 23;
	20	...	133	12	−12	7	G. and H. 17 −10, Sept.–Oct.; S. 9 −15, Aug.

The above are the best positions. The following radiants were also clearly marked, though apparently more inactive, and therefore less reliable, than the preceding.

Date.	No. T.	No. G.	Radiant Point.		No. of ↙ s	Confirms
			°	°		
Feb.	...	54	180	+27	5	D. 186 +24, Feb. Distinct to G. 11?
Feb.	...	188?	120	− 5	4	D. 117 −7, Feb. New shower?
Feb.	2	5	168	+ 4	5	D. 168 +4, Feb. Allied to No. 9?
Jan.–Feb.	...	...	295	+51	5	D. 295 +53, Jan. (20 ↙ s). Fine new shower.
Sept.–Oct.	72	133?	76	+ 9	6	T. 75 +15, Sept. 22. Allied to No. 17?
Sept.	...	193	44	+77	5	G. and H. 47 +74, Sept.
Dec. 12–17	...	162	66	+69	5	D. 69 +66, Dec. Active shower. S. 66 +65, Nov.
Dec. 12–23	...	180 183 ?	53	+ 3	5	S. 55 +5, Dec.; Clark 57 +6, Dec. 10–12.

Slight radiation also from about 118° +29° (Oct.), 344° +54° (Dec.), and 33° +21° (Dec.).

Bristol, April 7, 1877.

The Great Meteor of 1877, March 17. By Capt. G. L. Tupman.

A few minutes before 10 o'clock, G.M.T., on the evening of March 17, a meteor of very exceptional brilliancy was observed from the southern and western counties.

At Frome, 51° 14′ N., 2° 24′ W., it was seen by the Rev. G. Horner to begin 3° N. of *Pollux*, and terminate between γ and τ *Persei*.

At Cambridge, 52° 13′ N., 0° 6′ E., Mr. A. P. Trotter observed that its path and the line joining ε and ι *Orionis* bisected each other, the path being about twice as long as *Orion's* belt.

At Kensington, 51° 30′ N., 0° 12′ W., Mr. W. Thackeray saw it shoot from δ *Orionis*, downwards to the right, at an angle of 37° to the horizon.

At Gunnersbury, 51° 29′ N., 0° 17′ W., it appeared to come from *Gemini*, to pass over *Aldebaran*, and disappear below the *Pleiades* (*Nature*, March 22).

At Tetbury, 51° 38′ N., 2° 9′ W., Mr. E. C. Davis saw it disappear close to the *Pleiades*. Its path was inclined about 45° to the horizon, downwards and to the right.

At Rossall, 53° 55′ N., 3° 3′ W., it appeared to move from 3° north-west of α *Hydræ* to a point in R.A. $7^h\ 30^m$, Decl. 20° S. (*Nature*, March 29, and April 5).

At Brighton, 50° 49′ N., 0° 8′ W., Mr. W. Ainslie Hollis saw it disappear between the belt and the *Pleiades*, after describing a path of about 15°.

From these observations the radiant must have been very near R.A. 145°, N.P.D. 95°, or due *south*, at an altitude of 34°.

The point of disappearance is pretty accurately obtained at 29 statute miles over 5° 41′ N., 3° 4′ W. (near Pontypool). Combining, then, the Frome, Rossall, and Cambridge observations, as the most precise, the meteor first became visible 60 statute miles over 50° 59′ N., 3° 4′ W., or nearly over Taunton. This path satisfies the other descriptions within ordinary errors of observation. Its length was 59 statute miles. The duration was given as certainly about 3^s by Mr. Horner; 3^s by the observer at Gunnersbury; 4^s or 5^s by Mr. Hollis; 3^s by Mr. Ballard, at Banbury; and 2^s by another observer. The mean of these is $3^s{\cdot}1$, giving a relative velocity of 19 miles per second.

From the radiant point given above, the following parabolic elements of its orbit are deduced:—

	°
☊	177·4
I	8·5
π	222·5
q	·850

Motion Direct

whence the relative velocity is 13·3 statute miles per second, and the total duration $4\frac{1}{2}$ seconds.

The size of the meteor was described as one-sixth the diameter of the Moon, at Banbury, and also at Brighton, and one-half at Bristol, but doubtless this large size was chiefly due to irradiation.

During the first half of its track, the meteor was like burning magnesium in appearance, then the colour became red, and lastly was vivid green. All along its track fiery ashes fell towards the Earth, and after the extinction of the principal part, a body of dark red sparks continued to fall for a short distance, as seen at Tetbury by Mr. Davis. Lady Portsmouth, driving near Basingstoke, 90 miles from the meteor, and facing west, "was startled by what appeared to be blue or bluish-green lights falling apparently in large flakes into a field on her left. Some seconds after, while the whole country was lighted up as if by the brightest possible lightning, a large red ball was seen travelling with comparative slowness on the right, over a field, into which it appeared to fall." From Waterford the meteor was seen to be double, one part closely following the other. This duplicity is not reported from any other place.

The meteor left little or no streak, and did not detonate, for several of the observers state that they listened for any noise.

The average of all the recorded times is $9^h\ 57^m$ G.M.T.

In Mr. Greg's List of Meteoric Radiants for 1874, No. 15 is R.A. 143°, N.P.D. 97°, from January 3 to March 16 (?). Such a radiant would be nearly stationary for a long time, as the meteors overtake the Earth obliquely; its duration to March 17 is therefore confirmed.

A curious instance of the inaccuracy with which meteor tracks are sometimes described is that of "J. M. W." in the *Times*, who says that "in London the meteor was two-thirds the size of the Moon *when overhead*." As a matter of fact, it was never within 65° of the zenith of London.

Two Mechanical Solutions of Kepler's Problem.

By Prof. C. Pritchard.

It is unnecessary to dilate upon the boon which would be conferred on observatories and computers, if the tiresomeness of the solution of this problem can be diminished. Every skilful computer has no doubt his own peculiar method, which to him by habit facilitates the work more or less; perhaps that proposed by Dr. de Gasparis in the last Number of the *Monthly Notices* will be among the best. I venture to submit to the Society two mechanical methods of solution, which in the course of less than two minutes landed me just at the point reached in the ex-

ample given by Dr. de Gasparis above. The principle is as follows; but the description, if full, would occupy more time than the practical working of an actual case. Suppose a lath AB (fig. 1) divided into inches and tenths, and that two *trammels* slide upon it, accurately fitted. Each inch is intended to represent the length of an arc of a circle of one degree, the radius of which, therefore, is 57·296 inches. This subdivision into tenths is equivalent to one hundredth of an inch by estimation, and admitting of no error of that amount, i.e. no error amounting to 36″. The other implement required is a good carpenter's rule (fig 2) with a good hinge, with a line on each of the two laths, diverging from the middle of the hinge as the origin, and each line divided into the line of natural sines OC, OD to one tenth of a degree, and to the same radius as the lath. This implement forms, in fact, what is technically called a *sector*. Suppose the question were: "Having given M, the mean anomaly, = 15°·676, and the eccentricity $e = \cdot 5$, required the eccentric anomaly u."

The well-known form is $u = \mathrm{M} + e \sin u$.

Inasmuch as the sine of 30° is one-half of the radius, open the two legs of the jointed rule, or *sector*, until from 30° to 30° spans $\cdot 5 \times \sin 30°$, or one-fourth of 57·296 inches, i.e. 14·324 inches. It follows from the construction that, in the sector thus opened, from 10° to 10° will span $\frac{1}{2} \sin 10°$, and from 20° to 20°, $\frac{1}{2} \sin 20°$ &c., and so on for all corresponding divisions of the two lines of natural sines. The sector being thus prepared, take the divided lath and set one trammel (A) at the mean anomaly 15·68 inches, and let the other trammel (B) be moved backwards and forwards until a division (u) is found on it, such that from A to B will span across the space between the same identical divisions u to u on the opened sector; $u°$ is then the eccentric anomaly sought. In this example $u°$ turns out to be 30° *quam proximè*.

The reading of this description of the *modus operandi* has probably occupied more time than the working of an actual instance when once understood. The truth also of the method is obvious. For, from O to A on the lath is made to equal the mean anomaly, and from A to B, found as above, is $e \sin u$; consequently from O to B, i.e. the reading of B on the divided lath, is $\mathrm{OA} + \mathrm{AB} = \mathrm{M} + e \sin u = u$.

Practically, my own implements are, for convenience, constructed with a radius of 20 inches, and as these land us at once within 1′·5 of the true value of u, it is quite near enough for the application of the differential formula, finally completing the value of u. Of course, if the scales were absolutely divided, and could be so read, the solution above obtained would be strictly accurate. But supposing the reading thus obtained to be u_0, and the correct value $u_0 + \delta u$, then

$$\delta u = \frac{\mathrm{M} + e \sin u_0 - u_0}{1 - e \cos u_0}.$$

Fig. 3.

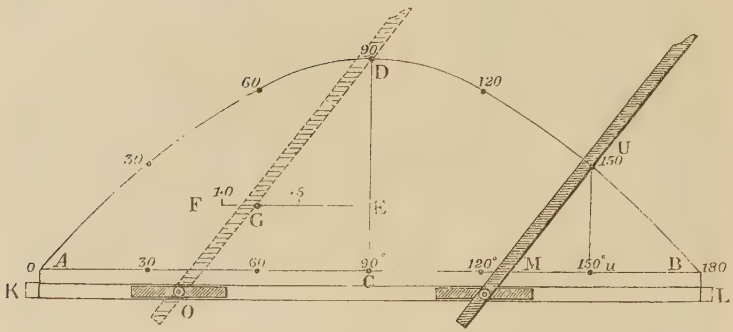


Fig. 4.

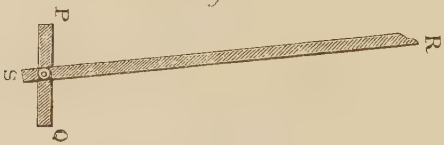


Fig. 1.

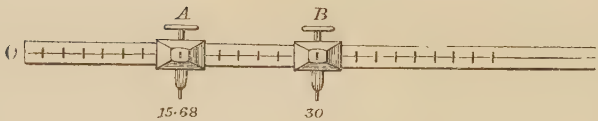
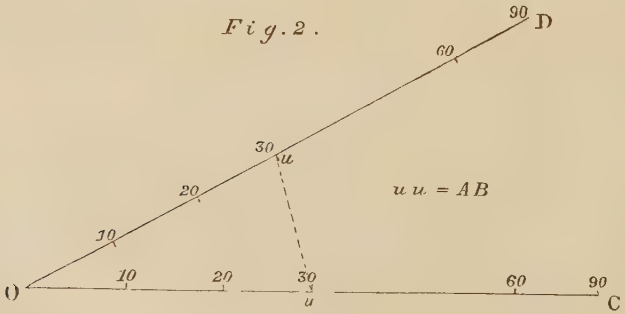


Fig. 2.



I will merely add that it is obvious that the length of the divided lath may be considerably curtailed in practice by a double *numbering* of the divisions, the upper numbering commencing (say) at 80° and proceeding to 180°, and the lower commencing with 0° and proceeding to 90°.

Other minor conveniences will suggest themselves to any computer of ingenuity, and the author of this paper will be happy to give any further assistance or description required.

Besides the preceding method, I have completed another contrivance, which is, perhaps, equally effective, and even somewhat easier to use, inasmuch as there is nothing *tentative* in its application. The germ of the thought will be found in the *Monthly Notices* a few years back, where Mr. Proctor refers to a method proposed by Prof. Adams, and which he there elaborates at some length, but which practically cannot well be utilised in computations. (See *Monthly Notices*, April 1873.)

The machine as used in the Oxford University Observatory is as follows:—

On a flat board is carefully stretched a sheet of paper, divided into squares of one inch, and subdivided again into squares of twentieths or thirtieths of inches.

This paper (or others like it) is supplied by Messrs. Waterlow, of Birchin Lane, London, and no doubt can be procured elsewhere.

From A to B is 45 inches (fig. 3), divided into 180 equal parts by means of the engraved lines. Each inch represents four degrees.

On this as base is erected the curve of sines so that CD, the sine of 90°, is equal to the radius, i.e. to the length of the arc of 57°·296, or 14·324 inches. DE is taken = 10 inches, and EF, perpendicular to it, is also 10 inches, divided by the engraved lines into twentieths of an inch. Below AB is a groove, KL, strictly parallel to the base AB. Into this groove is placed the slider PQ (fig. 4) carrying at its middle a thin lath with a perfectly straight bevelled edge, ROS, which, by means of a thumbscrew, moves round O, and can be thereby fixed at any inclination to PQ. The curvilinear part ADB is numbered correspondingly to the base ACD for every 10 degrees, and is capable of being read, by means of the engraved lines and estimation of subdivisions, to 2′ of arc.

The application of this simple implement to an actual example is easy and rapid.

For instance, let the mean anomaly M = 124°·933, e = ·875, and let it be required to find the eccentric anomaly U. For this purpose place the slide in the groove, and move the lath round O until the straightedge passes precisely against D and G, where the reading of G on the small scale EF is the eccentricity —here = 8·75 inches. Then clamp the lath by means of the thumbscrew; and slide it until its edge stands precisely against the mean anomaly M on the base, where the reading is here 124°·933 as near as estimation admits. Then the reading

U, where the straightedge cuts the line of sines, is the eccentric anomaly sought. In this instance U reads 150° *quam proxime*, but probably not exactly. Whatever the reading is, it can be treated in the usual way as a close approximate solution; and from it exactness to any amount of precision may be obtained by the application of the differential formula above. It will be observed that the only novelty here claimed consists in the application of the slider in the groove, thus obviating any drawing of parallel lines; and in the adaptation of the small scale EF, thus furnishing an immediate means of placing the straightedge at the proper inclination to the base ACB required by the eccentricity *e*.

This machine admits of home manufacture: and either of the two solves the question of Kepler's Problem with sufficient accuracy for double-star orbits without further computation.

The demonstration is obvious. For

$$\mathrm{M}u = \mathrm{U}u.\cot \mathrm{DGE} = \frac{\mathrm{GE}}{\mathrm{ED}}\cdot \mathrm{U}u = e \sin \mathrm{A}u;$$

hence

$$\mathrm{A}u = \mathrm{AM} + \mathrm{M}u = \mathrm{M} + e \sin \mathrm{A}u.$$

that is

$$e\mathrm{U} = \mathrm{M} + e \sin \mathrm{U}.$$

On the Inequality in the Moon's Longitude discovered by Prof. Newcomb. By E. Neison, Esq.

In my communication to the Society entitled "On the Lunar Perturbations arising from the Planet *Jupiter*" (*Monthly Notices*, xxxvii p.248), reference was made to a new periodical term in the Moon's Longitude of the form

$$\delta v = -1''{\cdot}163 \sin\{(2-2m_1-c)\,nt+f-2f_1+\mathrm{A}\},$$

where $(nt+f)$ denotes the mean longitude of the Moon, $(cnt+f-\mathrm{A})$ is the mean anomaly of the Moon, and (m_1nt+f_1) represents the mean longitude of *Jupiter*. Reducing the argument of this term to a form depending on the mean anomaly of the Moon $(=g)$ and a term increasing directly with the time, it becomes

$$\delta v = -1''{\cdot}163 \sin\{g+20°{\cdot}85\ (\mathrm{Y}-1855{\cdot}76)\},$$

or, what is the same thing,

$$\delta v = +1''{\cdot}163 \sin\{g+20°{\cdot}85\ (\mathrm{Y}-1864{\cdot}4)\}.$$

In his communication to the Society, "On a hitherto unnoticed Inequality in the Longitude of the Moon" (*Monthly Notices*, June 1876, p. 358), Prof. Newcomb describes a new empirical term discovered by himself, and which is

$$\delta v = -1''{\cdot}5 \sin\{g+\mathrm{N}°-90°\},$$

where

$$N = 163^\circ{\cdot}2 + 21^\circ{\cdot}6\,(t - 1868{\cdot}5).$$

Reducing this to the same form as the theoretical term, it becomes

$$\delta v = -1''{\cdot}5 \sin\{g + 21^\circ{\cdot}6\,(Y - 1865{\cdot}1)\}.$$

The two terms are therefore identical, with the exception of Prof. Newcomb's empirical term having the greater coefficient.

This fact entirely confirms the discovery made by Prof. Newcomb, and is obviously entirely unaffected by the existence of any discrepancy between the corrections to Hansen's Tables deduced by Prof. Newcomb and the observed corrections such as Capt. Tupman has made out.

Owing to an accidental error, which has just been detected, towards the end of the numerical reduction of the analytical results, the values of the co-efficients of the inequalities due to *Jupiter* given in the March number of the *Monthly Notices* are not quite accurate. They should be

$$\delta\frac{1}{r} = -0''{\cdot}578 \cos\{(2 - 2m_1 - c)\,nt + f - 2f_1 + A\}$$
$$-0''{\cdot}003 \cos\{(2 - 2m_1 - 2c)\,nt \quad - 2f_1 + 2A\},$$

and

$$\delta v = -1''{\cdot}163 \sin\{(2 - 2m_1 - c)\,nt + f - 2f_1 + A\}$$
$$+2''{\cdot}200 \sin\{(2 - 2m_1 - 2c)\,nt \quad - 2f_1 + 2A\}.$$

Comet 1877, *II., discovered by Professor Winnecke April* 5.

(*Extract of a Letter from Prof. Winnecke to Mr. Hind*).

"The new Comet was observed here by me on April 5, 6, and 7. From these observations Herr Hartwig has calculated the orbital elements :—

T	April 18·1741 Berlin Time.			
	°	′	″	
$\pi - \Omega$	65	51	21	
Ω	317	51	18	(1877·0)
i	123	17	18	
$\log q$	9·96767			

For the middle observation $\Delta\lambda = +2''{\cdot}0$, $\Delta\beta = -10''{\cdot}0$ (C − O).

"From these elements Dr. Schur has deduced the following Ephemeris :—

12h Berlin	R.A. h m s	δ ° ′	log *r*	log Δ
April 5	22 7 42	+14 41·9	9·9802	0·1458
„ 9	22 10 56	19 33·1	9·9736	0·1149
„ 13	22 15 5	25 8·9	9·9694	0·0831
„ 17	22 20 34	31 36·4	9·9677	0·0518
„ 21	22 28 11	39 0·0	9·9686	0·0226
„ 25	22 39 20	47 18·5	9·9719	9·9982
„ 29	22 56 53	56 19·4	9·9777	9·9812
May 3	23 27 48	65 33·2	9·9857	9·9742
„ 7	0 31 40	+74 0·3	9·9955	9·9783

"The analogy of these elements with those of the Comets 1827 II. and 1852 II. is great, and the circumstance of the intervals being nearly equal gives it a certain significance."

The Comets of 1877. By Professor C. Pritchard.

Borelly's Comet I.

The Ephemeris of Borelly's Comet was sent to me at the Oxford University, by the Astronomer Royal, on the 20th of February, and was observed here on the same night. Subsequently to this it has been observed 14 times, and of these observations nine are completely reduced; the remaining six await the co-ordinates of the comparison stars, which have been kindly promised by the Astronomer Royal. When this telescopic comet was first seen in our large refractor of $12\frac{1}{4}$ inches aperture it appeared to be sufficiently bright for observation with an aperture of probably 3 inches, and was, I believe, actually observed by Captain Tupman, at the Royal Observatory, with a telescope of that aperture. On the 30th March the comet was observed for the last time in our great telescope with considerable difficulty; on the 4th April it was too faint to be certainly seen in our instrument, and it is now probably out of sight. The whole series of observations will be presented to the Society as soon as the reduction is complete.

D'Arrest's Comet.

D'Arrest's Comet has here been looked for in vain, in the places assigned for it in Leveau's Ephemeris. The twilight and the Moon may render observations of this interesting body very difficult for some time to come.

Winnecke's Comet II.

From an observation made on the 5th of this month at Strasburg, and telegraphed to this Observatory by the Astro-

nomer Royal, together with two observations made here on the nights of the 7th and 11th inst., the following *preliminary* Elements and Ephemeris have been computed :—

T = April 19·98193 G.M.T.

π = 250° 48′ 27″
Ω = 318 2 21 } Apparent Equinox, Ap. 7.
i = 57 55 2

$\log q$ = 9·9748138

Motion retrograde.

Ephemeris for Greenwich Mean Midnight.

	R.A. h m	δ ° ′	log Δ
April 12	22 14·1	+23 29	
			0·1024
13	22 15·3	24 55	
14	22 16·5	26 24	
			0·0869
15	22 17·8	27 56	
16	22 19·2	29 31	
			0·0717
17	22 20·7	31 9	
18	22 22·3	32 51	
			0·0568
19	22 24·1	34 36	
20	22 26·0	36 25	0·0425

This comet as first seen here on the 7th inst. was tolerably conspicuous, with considerable condensation, approaching to a planetary nucleus, the whole nebularity, in early twilight, having a diameter of about a minute and a half. On the 11th inst., without apparent alteration in form or brightness, it was distinctly visible in a 2-inch telescope, and from the character of its orbit may probably become visible to the naked eye about the end of the month.

1877, *April* 13.

P.S.—Subsequently to the reading of this paper another Comet was discovered by Mr. Swift, of Rochester, U.S., on April 11, and, independently, on April 14, by M. Borelly, at Marseilles, in the Constellation *Cassiopeia*. This Comet was observed here on the 16th, and on every favourable opportunity since. The observations will in due course be communicated to the Society.

Note on a Deviation of the Plumbline. By M. Otto Struve.

It may be interesting to mention that extraordinary deviations of the plumbline have been discovered in the Crimea by M. Kortazzi, Director of the Observatory, Nicolayeff. For Falta, $\Delta\phi = +29''$, $\Delta\lambda = -28''$; for Sevastopol, $\Delta\phi = +5''$, $\Delta\lambda = +21''$. We are about to examine the matter accurately. As Falta has been a successful *Venus* station, the deviation may possibly affect the future computation of its parallax. Of course the geodetic co-ordinates should be used as deduced from undisturbed points, together with Greenwich time of transit corresponding to the deviated plumbline.

10*th March* 1877.

The Johnson Memorial Prize.

(Extracted from the *Oxford University Gazette* of January 23, 1877.)

The Trustees of the Johnson Memorial Prize for the encouragement of the study of Astronomy and Meteorology propose the following subject for an essay:—

The History of the Successive Stages of our Knowledge of Nebulæ, Nebulous Stars, and Star Clusters, from the time of Sir William Herschel.

The prize is open to all members of the University of Oxford, and consists of a gold medal of the value of ten guineas, together with so much of the dividends for four years on 338*l.* Reduced Annuities as shall remain after the cost of the medal and other expenses have been defrayed.

Candidates are to send their essays to the Registrar of the University, under a sealed cover marked 'Johnson Memorial Prize Essay,' on or before March 31, 1879, each candidate concealing his name, distinguishing his essay by a motto, and sending at the same time his name sealed up under cover with the same motto written upon it.

Correction.—*Monthly Notices*, vol. iii. p. 205, Feb. 1877.—An error of some magnitude in the "Report on the Progress of Meteoric Astronomy" (four last lines and the note att he bottom of the page) requires to be corrected. The date there given of an aërolite said to have fallen at Louisville, Kentucky, U.S., on the 8th, should have been on the 18th of July 1876. No coincidence of the date accordingly occurred (such as is mentioned in the note at that place) with that of the large meteor seen in Indiana, U.S., on the 8th July 1876.